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JOURNAL
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Vol. XXXII, No. 1. February, 1937.

# A Review of Crangoid Shrimps of the Genus *Paracrangon* found in Japan.*

Ituo KUBO.

(Received Nov. 11, 1936).

Of the crangoid genus *Paracrangon*, a single species, *P. echinata* Dana, has been known from the Japanese waters. An examination of the material obtained off NAGASIMA, Mie Prefecture at a depth of about 170 fathoms as well as the collection deposited in the Fishery Institute, Faculty of Agriculture, Tokyo Imperial University has added two new species to this genus, *P. abei* and *P. furcata*, which are described in the present paper.

The author takes this opportunity of expressing his warmest thanks to Professor A. TERAO for kindly supervising the present work. He is greatly obliged to Dr. Y. YOKOYA, of the Tokyo Imperial University, for placing valuable material at his disposal. Hearty thanks are also due to Mr. H. SATÔ, of the Tôhoku Imperial University, in the matters of important literature and to Mr. G. ABE for the collection of the material off Mie Prefecture.

## Genus *Paracrangon* DANA.

Dana, 1852, p. 533; Ortmann, 1895, p. 189.

### *Paracrangon echinata* DANA.

*Paracrangon echinata* DANA, 1852, p. 538, 1855, pl. 33, fig. 6; MIERS, 1879, p. 52; BALSS, 1914, p. 72; SCHMITT, 1921, p. 103, fig. 72; YOKOYA, 1933, p. 44.

* Contributions from the Zoological Laboratory, Imperial Fisheries Institute, Tokyo, No. 63.

Body small and robust. Rostrum compressed, long, slightly ascending, upper border usually with one spine in proximal one-third, lower border with one small spine near its tip and a long curved one near the base. Carapace with 4 unequal (mostly strong) spines on dorsal median carina, and 5 weak spines on intersecting points of low ridges which run on the lateral surfaces of the carapace. Antennal spine present, rather small. Pterigostomian angle ends in a large acute spine. Branchiostegal spine large, situated a little above the pterigostomian spine, dorso-ventrally depressed, furnished with a median shallow groove, and directed obliquely outwards.

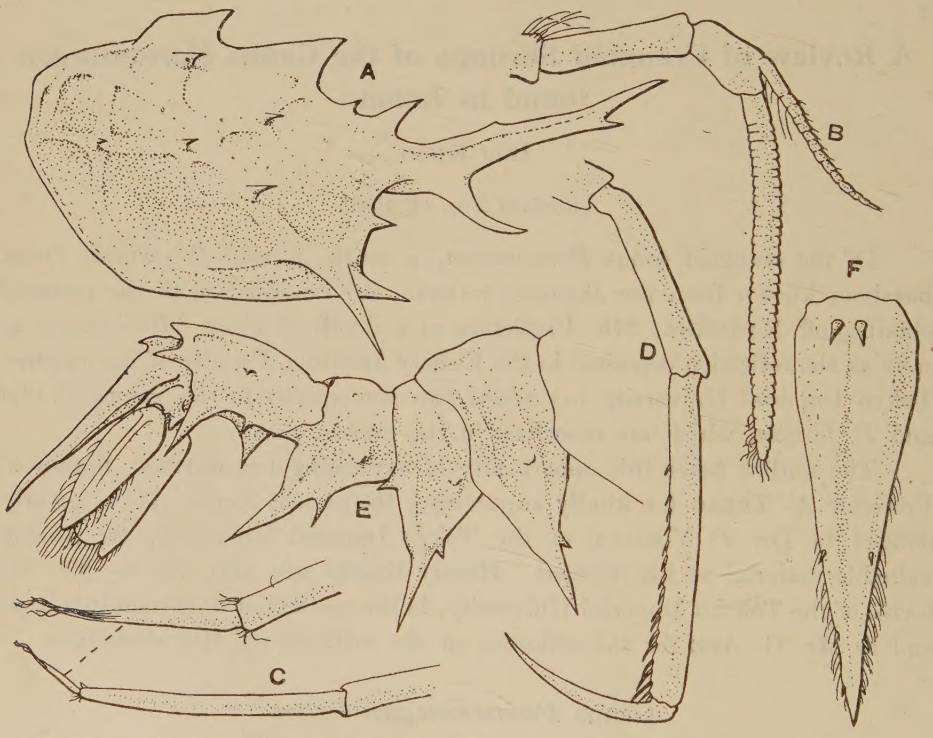


Fig. 1. A. Carapace with rostrum, ×5¼.
B. Antennule, ×7½.
C. Distal two segments of third thoracic leg, ♂, ×15.
D. Distal three segments of fifth leg, ×6. E. distal five segments of abdomen, ×5½. F. Telson, ×6.

Antennular peduncle consists of three segments, with a small lateral plate on proximal outer margin of basal segment and two unequal flagella at distal end of terminal segment. Outer flagellum with 35 joints, much thicker than

inner one which is composed of 14 joints (Fig. 1, B). Antennal peduncle long, its tip reaching to the distal margin of antennular peduncle, flagellum about 1.5 times as long as body length without rostrum. Third maxilliped reaching beyond antennal peduncle by the entire ultimate segment, ultimate one a little longer than penultimate one. First thoracic leg robust, carpus very short, about three-fourths the length of propodus. Third leg very slender, its dactylus about one-third the length of propodus, ending in a tuft of slender hairs (Fig. 1, C). Fourth and fifth legs much alike in appearance; fifth a little longer than fourth, its dactylus about half as long as propodus, and furnished with serrated spines on its posterior border. An acute spine in the middle of each of fifth to seventh of thoracic sterna, the one on the sixth the longest and the one on the seventh the shortest.

Third to sixth abdominal terga carinated, carina of third being especially high. A median groove on sixth and telson; abdominal pleura spiniform in both sexes; all pleura except sixth have a small lateral spine near the middle of anterior margin; a spine on the basal posterior margin of fourth and fifth; sixth with a stout lateral spine at anterior one-third; all abdominal somites, except sixth, have a long sharp pointed spine in middle region of each sternum, paired ones in the sixth; these spines smaller in female.

Second abdominal appendage has a stylumbris on the inner side of the endopodite in male.

Telson tapering, pointed and longer than uropods; a pair of prominent spines are situated in proximal region of dorsal surface; distal one-third armed with three pairs of small spines (Fig. 1, F).

Based on a male specimen measuring 46.5 mm in body length without rostrum.

Distributions: Alaska, Bare Islands, Vancouver (Lenz); Ochotsk Sea, Wladiwostok (Brashnikow); Sagami Bay (Miers); Todo-zaki, Kyôga-saki, Husan, Sado Islands (Yokoya).

## *Paracrangon abei*, sp. nov.

Rostrum long, straight, pointed, laterally compressed and shallowly sulcate; in female, directed obliquely upwards, provided with a small spine in the middle portion of anterior margin and a long curved one at base; on posterior border a small one situated in the middle of it; in male, directed obliquely forwards; the lower margin presenting entirely the same aspects in female but the upper margin armed with two spines, basal one with a very minute

additional spine in posterior basal region. Carapace carinated on dorsal median line, and armed with three spines, of these three, anterior two broad, laterally compressed and trifid at the apex (Fig. 2); sides traversed with carinae bordering larger or smaller areas; intersecting points of the carinae mostly provided with a spine. Antennal spine short but well developed. Pterigostomian angle ends in an acute spine. Branchiostegal spine long, directed obliquely forward.

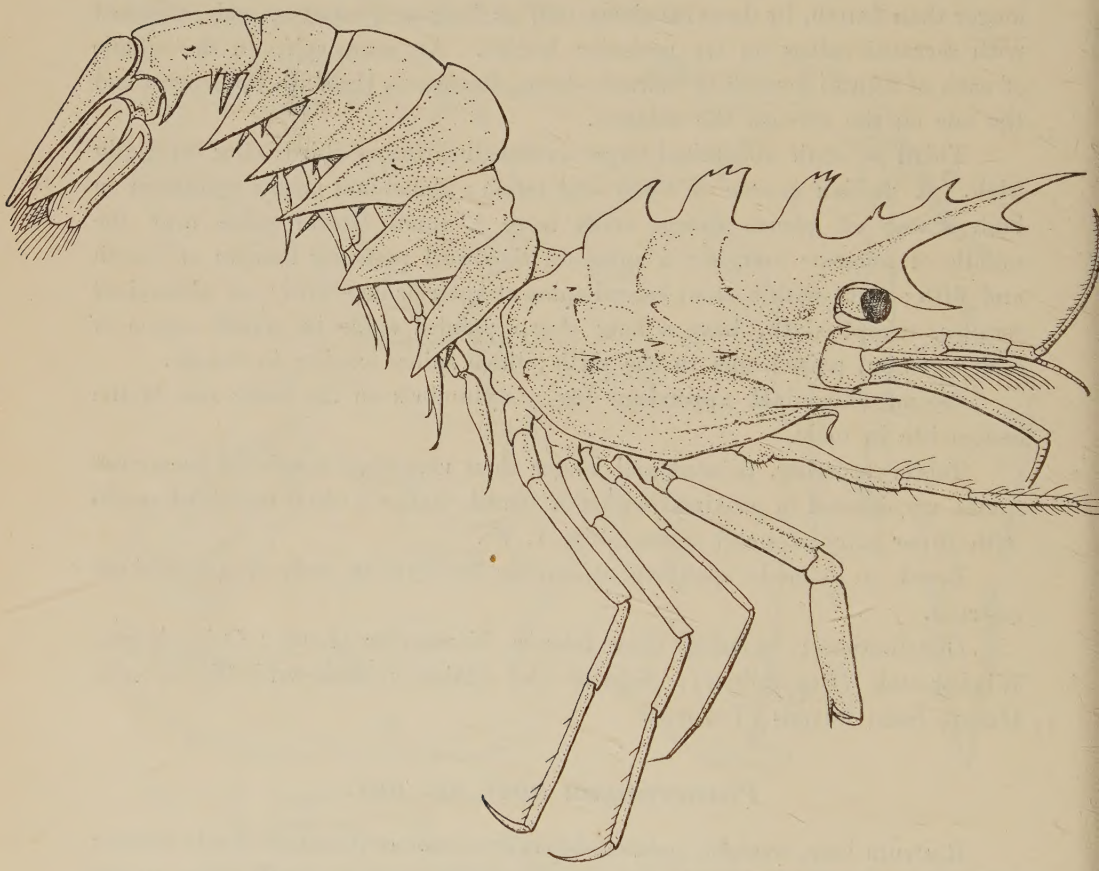

Fig. 2. *Paracrangon abei*, sp. nov. ♂, ×7/2.

Antennular peduncle consists of three segments, proximal one bearing a small lateral plate on the proximal outer side; distal segment carrying two rami; outer one with 31 segments, and inner one which is very smaller than

outer one, consists of 12 segments (Fig. 3, A). Distal end of scaphocerite reaching slightly beyond the distal end of second segment of stylocerite. Carpocerite long and a little beyond the distal end of stylocerite. Third maxilliped long, subcylindrical, surpassing carpocerite; pro-dactylopodite about 1.5 times as long as carpopodite. First pair of thoracic leg robust, slightly laterally compressed and shortest of all legs; propodus and merus subequal in length, but the latter somewhat longer than the former; carpus very short. Third leg very slender and longer than the preceding ones; tip of the dactylus torn into a large number of thread-like structures in both sexes (Fig. 3, C and D). Following two legs having close resemblance in all respects, though the hinder-most one is somewhat longer than the just former one; dactylus slightly curved inwards; propodus about 2.5 times as long as dactylus; posterior margin furnished with serrated spines (Fig. 3, E); carpus longer than $\frac{1}{2}$ times as long as propodus, merus subequal in length of propodus.

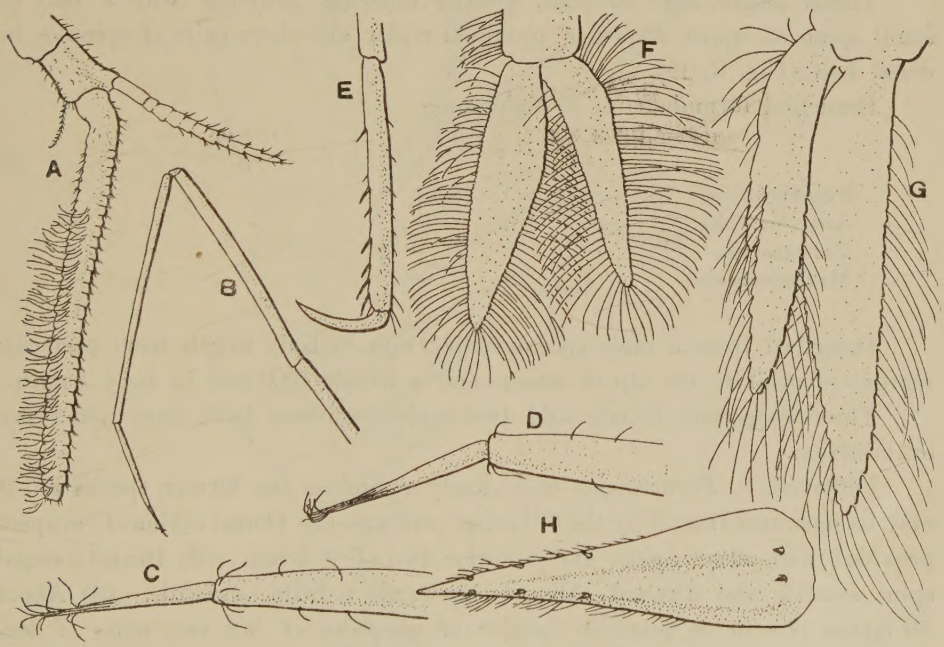


Fig. 3. A. Antennule, ca. ×10.
B. Distal three segments of third leg, ♂, ×7½.
C. Dactylus of third leg of male, ×50.
D. Dactylus of third leg of female, ×50.
E. Distal two segments of fifth leg, ×6.
F. Second abdominal appendage of female, ×6.
G. Second abdominal appendage of male, ×15.
H. Telson, ♂, ×7½.

Sterna of fifth and sixth thoracic segments bear a spinous median tooth in female, but in male specimen, each of posterior four somites carrying a spine in the middle region of sternum.

Tergum of abdominal segments carinated excepting the foremost one ; carina of third abdominal segment especially developed, it is sulcate along its median line in sixth and telson. Except sixth abdominal somite, all pleura ornamented with three transverse low carinae as shown in Fig. 2 ; the end sharply pointed but laterally flattened.

From first to fifth abdominal sterna armed with a long stout spine, while sixth segment is provided with a pair of smaller one on the anterior margin of sternum in male, but much smaller in female especially in first and second.

Endopodite of second abdominal appendage bears a stylumbris in male but not in female (Fig. 3, F and G).

Telson longer than uropods, distally tapering, provided with a pair of small spine on upper surface of proximal region and three pairs of spinules in distal half (Fig. 3, H).

Branchial formula runs as follows :—

| | *h* | *i* | *k* | *l* | *m* | *n* | *o* |
|---|---|---|---|---|---|---|---|
| Pleurobranchiae | — | 1 | 1 | ... | 1 | 1 | 1 |
| Arthrobranchiae | — | — | — | ... | — | — | — |
| Podobranchiae | — | — | — | ... | — | — | — |
| Mastigobranchiae | 1 | — | — | ... | — | — | — |

Described from a male specimen 34.0 mm in body length from posterior margin of orbit to the tip of telson, and a female 38.0 mm in body length.

Three ovigerous female and two male specimens have come under my examination.

Difference : *Paracrangon abei* closely resembles the former species but it may be separated from it by the following points :—(1) Dorsal carina of carapace provided with three spines and anterior two of it trifid. (2) Branchiostegal spine smaller and directed obliquely forwards a little outwards. (3) About 10 spines present on posterior border of propodus of last two pairs of legs (about 20 in *P. echinata*). (4) Pleura end in less prominent spines. (5) A pair of dorsal spines in proximal region of telson, smaller.

Type locality : Kumano-nada off NAGASIMA, Mie Prefecture (about 170 fathoms).

## *Paracrangon furcata*, sp. nov.

Body small. Rostrum laterally compressed, projected obliquely forwards

Fig. 4. *Paracrangon furcata*, sp. nov. ♀, ×5½.

and curved upwards in distal half: anterior margin bears a spine in distal one third and a forked one in proximal one third (Fig. 4); posterior margin without spine. Carapace carinated along dorsal median line. Carina armed with three spines; intermediate one, rudimentary. Sides of carapace subpentagonal in lateral view and ornamented with low ridges in such a way as shown in Fig. 4. Antennal spine very long, directed obliquely forwards. Pterigostomian spine small. Branchiostegal spine situated just behind pterigostomian one. A prominent spine planted near hepatic region.

Fig. 5. A. Antennule, ca. ×10.
B. Distal three segments of cheliped.
C. Distal two segments of third leg, 7½ and ×35.
D. Distal two segments of fifth leg, ca. ×10.
E. Second abdominal appendage of male, ×15.
F. Second abdominal appendage of ovigerous female, ×6.
G. Tail-fan, ×7/2.
H. Telson, ×6.

Antennular peduncle consists of 3 segments, upper margin of these segments densely fringed with long feathered hairs; basal segment bears a small lateral plate on proximal outer border; ultimate one shortest, about 2/3

times as long as second segment, bearing two rami. Outer ramus composed of 14 joints and much thicker than inner one; inner one rudimentary, with 5 joints (Fig. 5, A). Antennal peduncle long, distal end terminated at the same level of the distal end of antennular peduncle. Third maxilliped slender, reaching beyond distal end of antennal peduncle by the entire ultimate segment; ultimate and penultimate ones same in length. First thoracic leg robust. Third leg slender; dactylus ends in a tuft of bristles (Fig. 5, C); propodus cylindlical and enlarged (Fig. 5, C). Last two pairs of legs very similar in all respects; propodus two times as long as dactylus in fifth leg; posterior margin fringed with long hairs instead of spinules (Fig. 5, D). All thoracic somites without median spine on sternum.

Abdomen except anterior two somites carinated, especially in third abdominal somite; sixth and telson with median groove on dorsal surface. Transversal median and two marginal low carinae (as shown in Fig. 4) on the lateral sides of first to five abdominal somites. Sternum of anterior five segments has a long spine in its middle region in male, but it is rudimentary in female. Anterior margin of sternum of sixth abdominal segment armed with a pair of tubercles in both sexes.

Second abdominal appendage has a stylumbris on inner side of endopodite in male specimen, but without in female (Fig. 5, E and F).

Telson tapering, a little longer than uropods (Fig. 5, G); furnished with three pairs of spinules in distal one-third (Fig. 5, H).

Branchial arrangements are the same as in previous species.

Above mentioned description is based on a male specimen, 26.0 mm and ovigerous female, 38.0 mm in body length without rostrum. One male and 9 ovigerous female specimens were used for this study.

Type locality: Kumano-nada off NAGASIMA, Mie Prefecture at a depth of about 170 fathoms.

Difference: *Paracrangon furcata* is closely allied to the already described two species, but should be separated from them as shown in the following table:—

| | *P. echinata* | *P. abei* | *P. furcata* |
|---|---|---|---|
| 1. | Rostrum straight, anterior margin with two simple spines, lower one curved. | " " | Curved upwards in distal half, anterior margine with a simple spine and a forked one in basal region. |
| 2. | Dorsal carina of carapace with usually unequal 4 spines. | With usually three spines, anterior two are trifid at tip. | With usually two large and one small spines. |

| *P. echinata* | *P. abei* | *P. furcata* |
|---|---|---|
| 3. Antennal spine short. | „ „ | Very long. |
| 4. Branchiostegal spine very long, directed obliquely outwards. | Moderately long, directed obliquely forwards. | „ „ |
| 5. Outer antennular ramus consists of 35 segments, inner one about ½ times as long as outer one and composed of 14 segments. | Outer ramus composed of 31 segments, inner one about ½ times or more as long as outer one and consists of 12 segments. | Outer ramus short and consists of 14 segments, inner one rudimentary, bearing 5 segments. |
| 6. Propodus of 3rd leg slender, viz., normal in shape. | „ „ | Enlarged, viz., abnormal in shape. |
| 7. Posterior margin of last two pairs of leg armed with about 20 spinules. | Provided with about 10 spinules. | Fringed with hairs, instead of spinules. |
| 8. Pleura spiniform, anterior margin bears a marginal spine, 4th and 5th armed with one posterior marginal one. | Pleura accuminated but not spiniform, anterior marginal spine and posterior one present, but smaller than those of the former spicies. | Pleurae accuminated but not spiniform, without both marginal spines. |
| 9. With a pair of spines on dorsal surface of telson in proximal region. | „ „ | Without. |

## *Key to all the hitherto known species, belonging to the genus Paracrangon.*

a. Rostrum straight, obliquely directed upwards, anterior margin with two simple spines, posterior margin with one or two spines.

b. Dorsal carina of carapace with three flattened spines and anterior two trifid at tip. ..... *P. abei*, sp. nov.

bb. Dorsal carina of carapace with 3~4 unequall spines and its apex does not trifid.

c. outer antennular ramus comprising about 22 segments. Pleura of abdominal segments accuminated but not spiniform..... *P. areorata.*

cc. auter antennular flagellum composed of about 35 segments. Pleurae of abdominal segments pointed and spiniform..... *P. echinata.*

aa. Rostrum curved upwards in distal half; anterior margin with simple spine near its tip and a forked one near basal portion; posterior margin with no spine. Outer antennular ramus consists of about 14 segments; inner one rudimentary composed of 5 segments. .....
*P. furcata*, sp. nov.

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# Studies on the Deep Sea Fishes of Japan[1]

## III. On Some Remarkable Variations found in *Paramyxine atami* DEAN with Special Reference to its Taxonomy.

Kiyomatsu MATSUBARA.

(Received Jan. 15, 1937)

In 1904 DEAN[2] described a myxinoid, *Paramyxine atami*, on the basis of a single specimen from the Sagami Bay. As detailed as it is, his account does not enable one to decide whether or not the various characters which he considered to be peculiar to the species are merely individual variations, inasmuch as nothing has been added to our knowledge of it.

The author has had of late an opportunity to examine 14 specimens of a myxinoid obtained from Kumano Nada at a depth of about 150 fathoms located south-east to Kii Peninsula and has come to the conclusion that they are referable to the above-mentioned species although discrepant in several characters as given in the present paper.

A grateful acknowledgment is made to Prof. Arata TERAO for his invaluable help given in the course of the present work. The writer wishes to express his best thanks to Mr. Genkiti ABE for his kindness in supplying most of the specimens used in the present work.

### Descriptions of variations

1) *Arrangements and shapes of openings of branchial ducts:*

Of the 14 specimens ranging from 343 to 475 mm in entire length, only one is provided with the openings arranged in a row on both sides as in the type specimen of *Paramyxine atami*, 2 with those lined up somewhat regularly in two rows on either side and the remaining 11 with irregularly disposed ones (Fig. 1 and Plate I).

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1) Contributions from the Zoological Laboratory, Imperial Fisheries Institute, No. 64.

The expense of this work has been defrayed by the research fund from "Hattori Hôkôkwai" (Hattori Gratitude Foundation). The first and second communications appeared in the Zool. Mag., 48 (11), 1936.

2) *Vide*: DEAN, B., 1904: Jour. Coll. Sci. Imp. Univ. Tôkyô, 19 (2), p. 14.

The openings of branchial ducts and those of ductus oesophagus are either round, ovate, elliptical, or much irregular in shape. Not a single specimen, however, is found with the opening of ductus oesophagus compressed

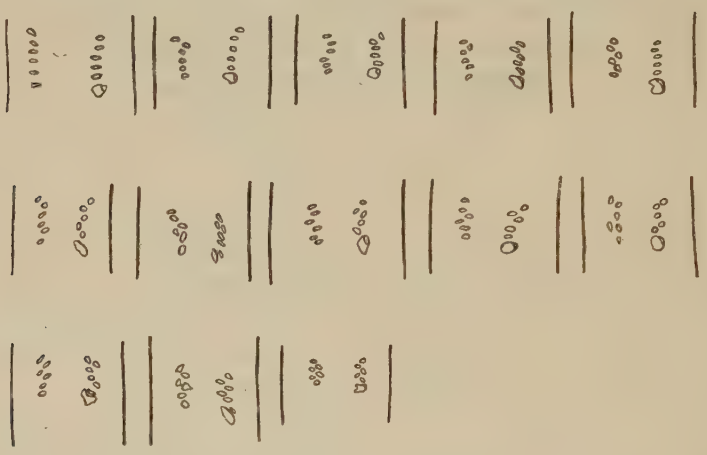


Fig. 1. Showing the variations of the arrangement of openings of branchial ducts ×½.

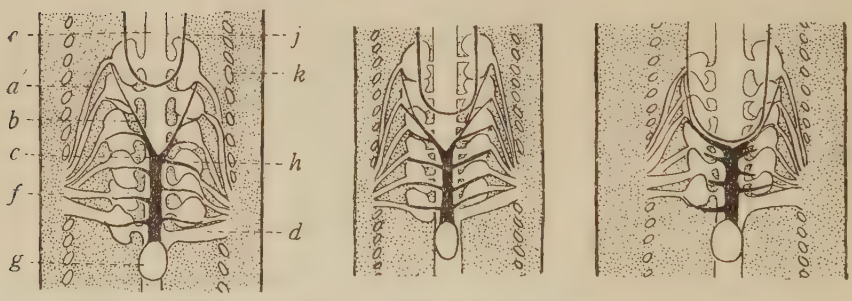



Fig. 2. Showing the variations of the extention of base of tongue muscle ×½. *a.* ectal branchial duct; *b.* afferent branchial artery; *c.* bifurcation of afferent aorta; *d.* ductus oesophagus; *e.* gut; *f.* opening of ectal branchial duct; *g.* heart; *h.* gill-sac; *j.* dark line showing the position of tongue muscle; *k.* mucous gland.

longitudinally as in the type specimen. It seems to me that the outline of the openings in question is liable to changes during preservation.

2) *Position of the base of tongue muscle:*

The base of tongue muscle is situated between the second pair of branchial sacs in 10 specimens, between the first pair in one, and it reaches between the

third pair in the remaining three as is the case with the type specimen (Fig. 2).

3) *Dentition:*

The dental formula $\frac{13}{13}\Big|\frac{12}{13}$ of the type specimen does not hold for any of my specimens, in which 10 or 11 teeth are present on the inner and outer rows. Three teeth near the median of the outer row are fused at their basal parts just as those of the type specimen. But no specimen is found provided with the three teeth of the inner row fused as those of the type specimen, all with two teeth adjacent to the median of the inner row fused at their bases. The teeth are orange yellow in all but one which has milky white teeth.

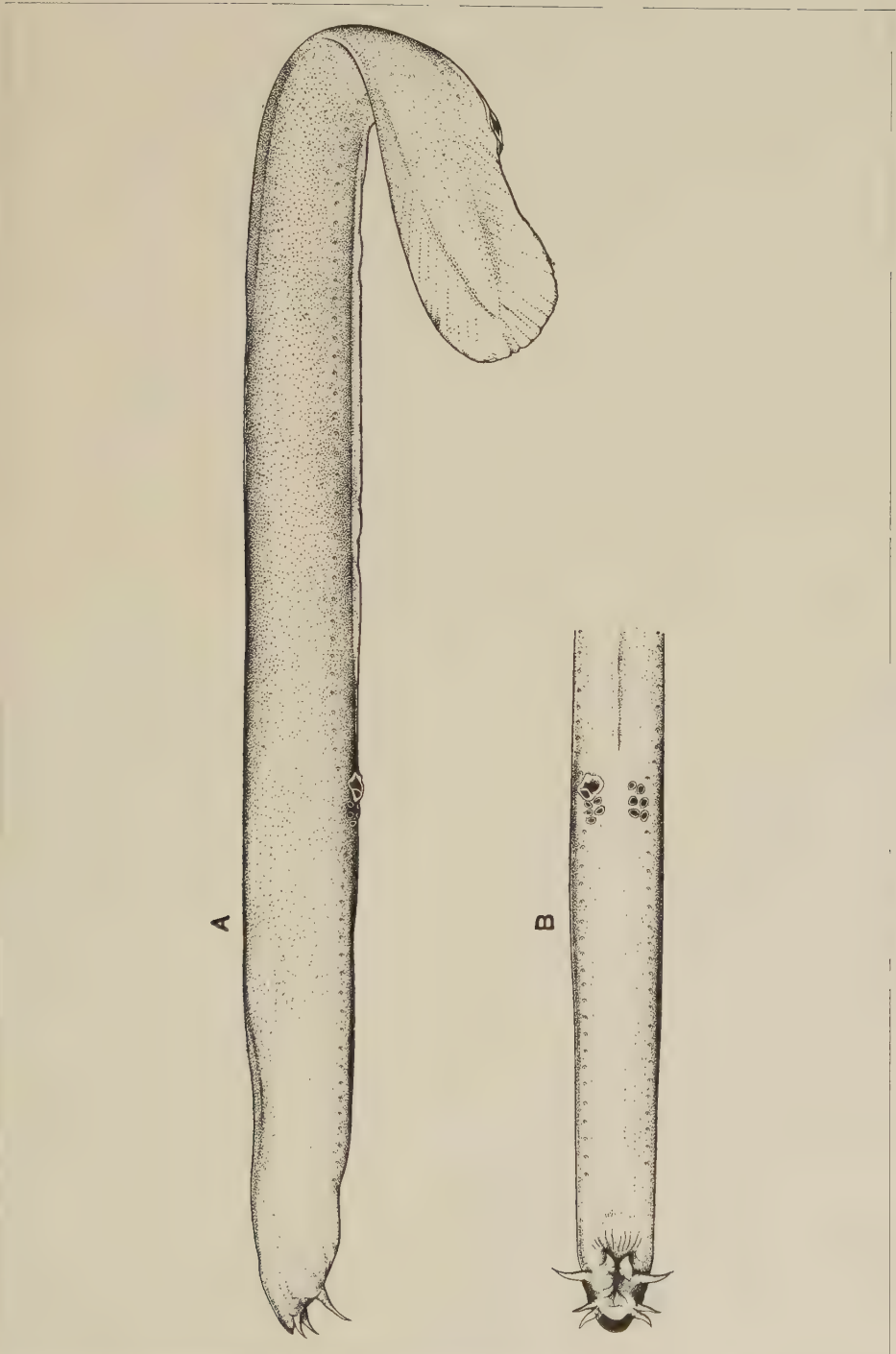
Fig. 3. Dentition ×2.

## Discussion

In taxonomical study of myxinoids in general, the number of openings of branchial ducts, the correlation of the lengths of all ectal branchial ducts, the mode of arrangement of all openings of branchial ducts, the position of the base of tongue muscle and the dental formula are considered of much importance. Of these five, the last three items, as already mentioned, did not serve my purpose. But it goes without saying that the material at my disposal constitutes a series of gradual changes which should go as fluctuations within one genotypic group. Any splitting into subgroups would lead to nothing but confusion. It follows therefore that the taxonomic criteria of the myxinoids must needs be thoroughly revised from anatomical and embryological view-points.

Explanation of Plate I. *Paramyxine atami* DEAN with two rows of openings of branchial ducts on each side ×⅗. A. Lateral aspect. B. Ventral aspect of anterior half of body.

Pl. I.



# Larvae and Young of Fishes found in the Vicinity of Kominato, VII~VIII*

Syûya Nakamura.

(Received Nov. 5, 1936)

## VII. *Cololabis saira* (Brevoort).

The present paper embodies my observations done under the supervision of Professor A. Terao on the development and metamorphosis of the teleost, *Cololabis saira* Brevoort.

The author is greatly indebted to Professor A. Terao for his kind supervision of the present work. He is also under obligation to Asst. Prof. S. Yoshida and to Mr. S. Kawahara and Mr. Ishiguro, of Fisheries Experimental Station of Tiba Pref., for the collection of the material.

This fish is widely distributed from Hokkaidô to Kyûsyû and it occurs most abundantly off Prov. Bôsyû during a period from November to December. But facts point to the conclusion that the fish appears in the region in question twice a year to spawn, viz., from April to June and from September to February with the respective heights of the spawning seasons lasting from May to June and from November to December. The gill-nets capture 3 or 4 year-old spawning individuals of *Cololabis saira* in November and December, with clusters of the eggs of the fish eventually adhering to the nets.

The drifting algae are found in June agglutinated with egg-masses which show varying stages of development. The fry hatched from the eggs laid in November or December pass the winter near the water-surface off Prov. Bôsyû and still sojourn at the same water-surface until April to May when they attain a length of 10~15 cm. But nothing is known of the fate of the fry hatched from the spring eggs. My observations on the early development of this fish stand in many respects at variance with those of Kurakami and Miyauchi and will be given in the following paragraphs.

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* Contributions from the Kominato Marine Biological Laboratory, Bôsyû (No. 3), and from the Zoological Laboratory, Imperial Fisheries Institute, Tokyo (No. 65).

*Egg and embryo.* The egg is provided with a tuft of more than 10 adhesive filaments, with which it is attatched in cluster to various objects floating on the water-surface. It is either spherical or oval in form measuring 1.58～1.89 mm × 1.53～1.76 mm. Numerous small oil-globules are seen through the chorion and a number of dot-like black pigments make their appearance on the body and on the yolk-sac. Dorsal embryonic fin starts at a

1/2 mm

Fig. 1.

1/2 mm

Fig. 2.

spot slightly anterior to the line drawn vertically to the anus. The chromatophores branch out arborescently as the development advances and are seen blackish in colour. The embryo is seen rather actively moving beneath the chorion at such a stage as shown in Fig. 1.

In the more advanced stage, the chromatophores are either dot-like or stellate in outline, and ever increasing in number so that the entire body turns blackish. Soon after that (Fig. 2) the dorsal part changes to greenish blue in colour and is provided with fundaments of the scales. A longitudinal sky-blue band runs a little above the median line of the lateral side of the trunk. The body is bluish-white below this band. The yolk is being

rapidly absorbed. The mouth is already movable; definitive fin rays are laid down in the caudal fin; the body is seen vigorously moving; and the hatching soon ensues. Thus, this fish spends the larval life within the chorion until the body is built up to the post-larval stage.

*Post-larval stage.* The fry just after hatching measure 6.8 mm. to 7.8 mm. in total length and are found swimming at the surface of sea.

In a fry of 7.0 mm. length (Fig. 3) the general outline of the body is much similar to that of *Hyporhamphus sajori* (Tem. & Schgl), being very elongate in general appearance with the height greatest at a spot where the yolk was formerly located. The eye is very large and situated near the top of very short snout, and the outline of anterior part of head is much rounded off unlike that of the adult. Lower jaw is slightly longer than upper one. Anus opens a little behind the middle of the ventral side. The pectoral fins

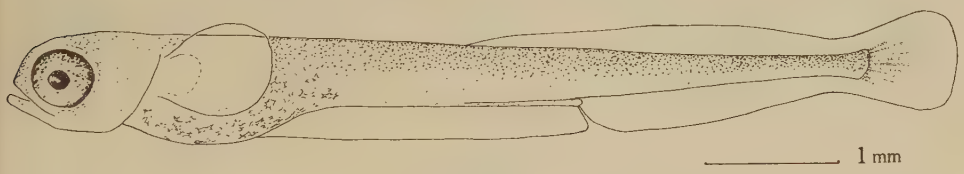


Fig. 3.

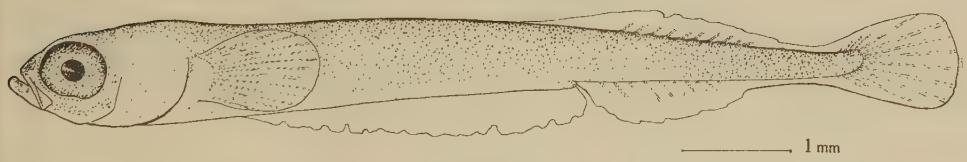


Fig. 4.

are large and fan-shaped, but the ventrals do not yet appear. The continuous unpaired larval fin of dorsal arises at about the middle of the body. The fin rays are found only in its caudal portion which is uniformly rounded off. The coloration of body is the same as that of the embryo just before hatching.

The smallest fry that I have ever obtained by surface tow measures 8.7 mm. (Fig. 4) in total length, and resembles the embryo of 7.0 mm length in general appearance but the snout is slightly pointed and both the dorsal and anal fins are respectively provided with ten unjointed soft rays. Its coloration is blue on dorsal, light bluish on lateral, faintly bluish white on ventral side, and silvery on opercles, breast and abdomen. In a larva 15.5 mm.

(Fig. 5) long, 12 rays of dorsal fin and 14 rays of anal fin, 4 rays of dorsal side of peduncle, and 5 rays of ventral side of peduncle are formed, all being enclosed by continuous fin membrane. The ventral fin is already seen rudimentally formed at the mid-point between tip of pectoral fin and anus. The caudal end becomes slightly concave. The coloration is almost the same as that of the previous stage.

A small young 26.0 mm. in length (Fig. 6) appears to be nearly the same as the adult. The larval fin anterior to the anus is retained until the fish reaches 20 mm. in length, but all larval fins disappear at this stage. The finlet formation now begins. The ventral fins are considerably enlarged; the caudal end is more deeply notched. The lower jaw fairly projects beyond the upper as in the adult fish. The dorsal side is still deep blue in colour and the ventral side is silvery.

Fig. 5.

Fig. 6.

*Discussion.*

From an examination of his material from Hokkaidô, Kurakami stated that (1) the egg of the present species assumes a perfect spherical form measuring 2.06 to 2.13 mm in diameter and (2) the fry just after hatching is 7.09 mm in length, coloured bluish green on dorsal and yellowish on ventral, in which yolk is still left unabsorbed, and provided with dorsal fin membrane arising immediately behind the head. As already described, my material from Bôsyû stands at variance with his in the following points:— (1) the egg is ellipsoidal with its major axis ranging from 1.58 to 1.89 mm

and minor axis from 1.53 to 1.76 mm; (2) the just hatched fry measures 6.8 ~7.8 mm in length, presents a deep blue colour on dorsal and a bluish white one on ventral, in which almost all yolk is used up, and has the dorsal fin-membrane inserted a little posterior to the middle of the body. These discrepancies are, according to my opinion, too great to be taken for those due to local variations of the same species. Miyauchi published an account on the development of *Cololabis saira* on the basis of the material from Ibaraki Prefecture. But his observation does not go farther than early cleavage stages so that it does not give any clue for the solution of the question *sur la tapis*.

The fact that the breeding season of the present species occurs twice a year in the vicinity of Prov. Bôsyû suggests a question as to whether or not one and the same stock of this species spawns in two separate seasons in a year. A thorough study of the breeding season in all the regions is extremely needful in this connexion.

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## VIII. *Hyppocampus japonicus* Kaup.

An incubating male of *Hyppocampus japonicus* was obtained near the Kominato Laboratory on September 21, 1932 and on July 8, 1935 respectively. They liberated young when kept in the aquarium. The young of different stages of development were also got from time to time in the vicinity of the Laboratory. Thus, the author could trace a nearly complete series of development from the old embryo to the adult as well be given is the present paper. The author begs to record here his indebtedness to Professor A. Terao for his kind guidance under which this work was carried out.

*Habit.* This species is widely distributed from Hokkaido to southern Japan, mostly in the algal thicket of the littoral zone. I could not observe the male and female in the act of transfer of the eggs, but perhaps this peculiar habit takes place in this species as is the case with other species. The spawning season of this fish seems to be summer in the neighbourhood of Kominato since the incubating males were found in summer in this district. The adult sea-horses were seen to prey on the living free-swimming copepods in aquarium.

*Embryo.* The form of egg when taken out of the ovigerous pouch is nearly ellipsoidal, with its major axis 1.73～2.01 mm long and its minor axis 1.58～1.73 mm long. The chorion is produced on one side in the form of papilla-like process which is 0.41～0,60 mm long (Fig. 7). The form of the chorion is subject to changes when the embryo grows old and exerts active bodily movement. One can often observe the lengthening of it caused by the stretching of the embryo beneath it.

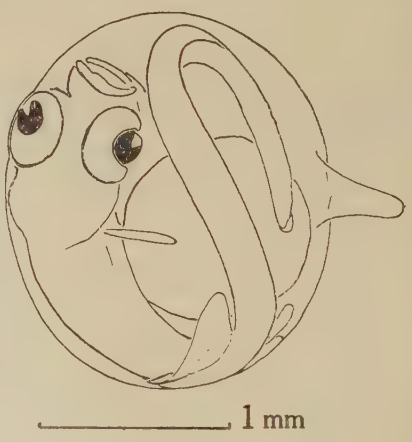

Fig. 7.

I could not examine the embryonic stage earlier than the one shown in Fig. 1. Fig. 8 represents the embryo of this stage taken out of the chorion.

At this stage three rings encircling the body trunk and four rings encircling the tail behind the anus are weakly developed, and between each ring three or four rings are faintly visible. Head is very short and meets body

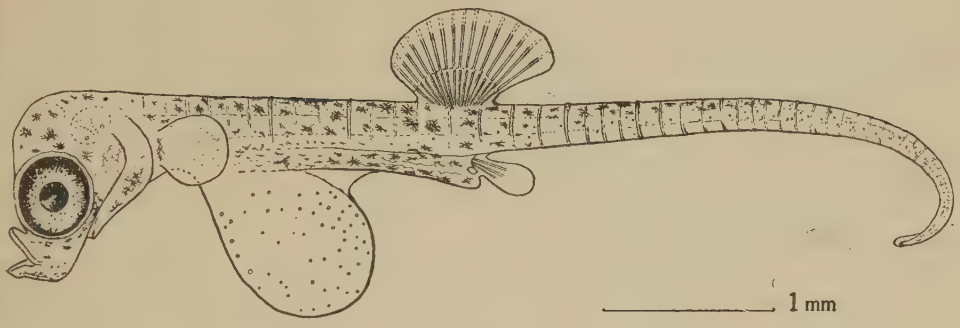


Fig. 8.

axis at right angles; the snout is directed at right angles to head and parallel with body axis. The eyes are very large, about half the head length. The dorsal has 16 soft fin rays; the fan-shaped pectorals have no distinct rays and are situated just behind gill clefts; the anal is provided with 3 soft fin rays and located at the posterior end of abdomen; rudimentary caudal fin is visible at the end of the tail.

The faintly-coloured branched melanophores are somewhat densely seen in the anterior part of body and sparsely on tail, especially so on inner side of tail and on the yolk-sac. Red dot-like pigments of the same colour as that of oil globule are seen mostly on ventral side of body. Yellow pigments usually assemble on the dorsal side of the protuberant ring in a numbers of five or six but are scattered elsewhere so that the body seems rather redish yellow in colour. The dorsal fin rays, are margined with black near their distal end.

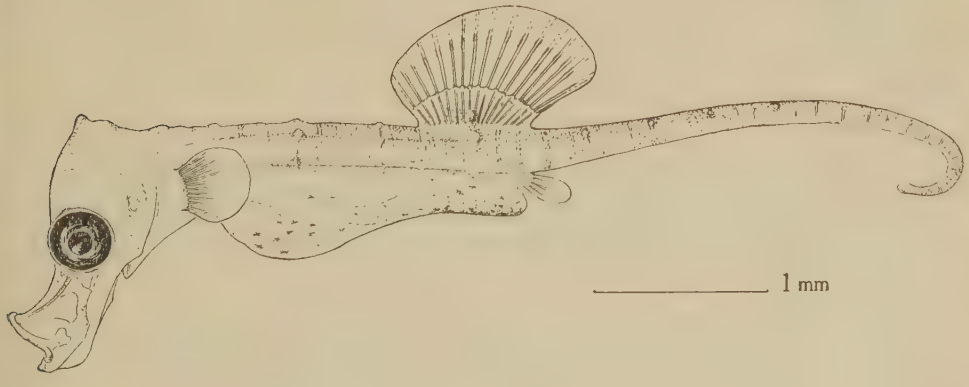


Fig. 9.

Twenty hours later, the embryo reaches the stage as shown in Fig. 9 which is characterized by considerable absorption of the yolk, and appearance of projections on the protuberant rings. These projections are three in number on each ring of the trunk and one on each of the tail. Secondary protuberant rings make their appearance between the primary ones.

A triangular process appears on occiput. Simple, almost straight alimentary canal is seen surrounded by the yolk. Yellow pigments still exist on the dorsal side of the protuberant rings, but the reddish pigments have already disappeared on the ventral side of the body. The branched melanophores become denser, spreading over dorsal and ventral sides. The red oil-globules are still visible in the yolk which is now of very small quantity. The anterior part of abdomen is reddish in colour owing to the presence of the yolk.

*Young.* Young fish at the complete absorption of the yolk (Fig. 10) measures 67 mm. in length. This stage is reached in about 48 hours after the hatching. The snout is much elongated so that the eye attains about 1/5 the head length.

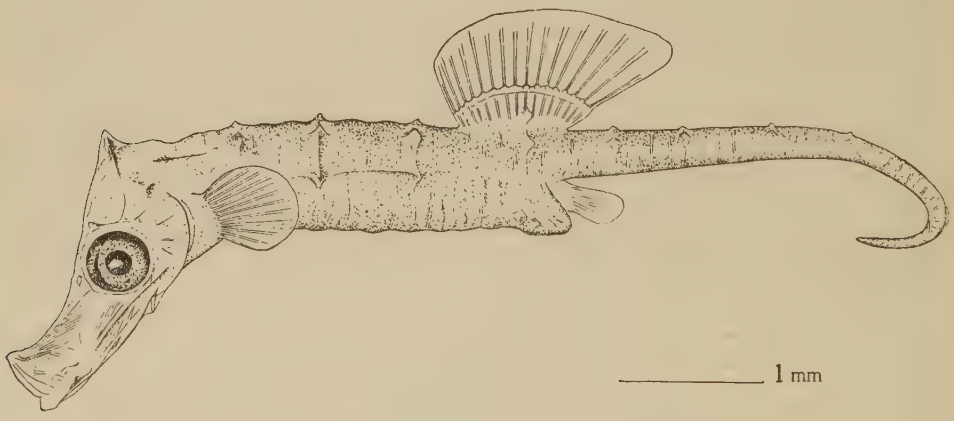


Fig. 10.

Four primary protuberant rings on the trunk and five of those on the tail become much prominent. The processes on these rings are triangular. The secondary rings which exist between primary rings are now much developed.

The process of occiput is directed backward. One process is situated close to upper and posterior margin of the eye, and two processes on the post-orbital. The ground colour of the body is brown or brownish black and the melanophores are almost uniformly distributed on the body.

In a specimen about 20 mm. long, the secondary rings between primary rings are much prominent with triangular processes on each. Pectorals are still directed backward.

Body colour is the same as that of adult fish.

In the adult fish, the primary rings are a little stronger than the secondary rings, both primary and secondary rings being 11 in trunk and about 39 in tail. Primary rings are provided with a flap on dorsal side.

*Measurements of young.* Measurements of the lengths of head, trunk, and tail of ten young fishes taken out of the pouch of the male, which was obtained on July 8th 1935, were done and the mean values were computed. The following table lists also the measurements of another young and the adult male, from which the young were obtained.

| Date | Head | Trunk | Tail | Note |
|---|---|---|---|---|
| July 8th | 0.91 | 2.58 | 3.18 | Just hatched fry. |
| „ 9th | 1.25 | 2.59 | 3.03 | |
| „ 10th | 1.32 | 2.77 | 3.17 | |
| „ 11th | 1.89 | 3.12 | 3.23 | |
| „ 13th | 2.07 | 3.26 | 3.45 | |
| | 5.6 | 10.5 | 15.0 | Young fish obtained at Hamano, Tokyo Bay, on July 14th, 1935. |
| | 10.0 | 16.0 | 33.0 | Adult fish, from which the above-mentioned young were taken out. |

As shown above, the head rapidly grows longer due to an unusually fast lengthening of the snout. The length of tail is about 3.18 mm. just after hatching; it suddenly decreases for one or 2 days afterwards but it decidedly increases again four days after hatching.

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# Sciaenoid Fishes Found in Japan and its Adjacent Waters*

Kiyomatsu Matsubara

(Received Feb. 14th, 1937)

The fact that the Sciaenoid fishes are very important in connexion with the economy of Japan, Tyôsen and China Seas necessitates fundamental researches in these fishes from the view-points of systematics. It appears, however, that the taxonomical studies of them that have hitherto been made are far from complete in many respects since they vary so much according to individuals, localities and growth-stages that they are apt to be taken as one species for their appearance, and *vice versa*. The writer, therefore, has made statistical studies of these fishes on the basis of a large number of specimens with a view to determine the extent of variation of each species. As regards the fishes belonging to *Collichthys* and *Laramichthys* he will defer publishing the result of his investigations until he has sufficient materials. The specimens used in this work were procured from Siogama, Tôkyô Bay, Miya in Aiti-Ken, Kôbe, Hirosima, Simonoseki, Nagasaki, Simabara, Tyôsen and China Seas.

In this work, the length of body is indicated by a measurement from the tip of the snout to the base of the middle ray of caudal fin; the depth of body by that of the perpendicular depth immediately in front of the base of ventral fin; the length of maxillary by that of the length of upper jaw. The age of the fish is estimated by the number of annual rings seen on the scales.

The writer must express his sincere gratitude to Dr. Arata Terao and Dr. Morisaburo Tauti for their kind guidance given him in this work. He offers his best thanks to Messrs. Keitarô Uchida, Hiroshi Yoshida, Susumu Nakano, Ken-ichi Ebina, Genkichi Abe and Saburo Kuramoto for their assistance rendered in obtaining the materials.

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## Fam. Sciaenidæ.

Sciaenidæ (pars) OWEN, 1846, p. 49.
Sciaenidæ GÜNTHER, 1860, p. 265.

### Key to genera of Sciaenidæ.

a. Several pores on mandibular symphysis; no barbel at chin.
  b. Soft dorsal and anal naked or partly scaly.
    c. Inner row of mandibular teeth enlarged....*Nibea*.
    cc. No enlarged teeth on mandible .....*Johnius*.
  bb. Soft dorsal and anal wholly scaly .....*Pseudosciaena*.

### Genus *Nibea* JORDAN & THOMPSON

*Nibea* JORDAN & THOMPSON, 1911, p. 246. Type: *Pseudotolithus mitsukurii* JORDAN & SNYDER.

### Key to species of *Nibea*

a. Scond anal spine very long and strong, usually longer than 1/3 the length of head (nearly as long as or somewhat shorter than 1/3 the length of head in *N. goma*); dark oblique streaks or black spots run along rows of scales.
  b. Soft dorsal rays 25 to 31, but usually more than 26; gill-rakers on first arch not fewer than 16.
    c. Jaws nearly equal; preopercular margin crenulate, but devoid of true spines; body not tinged with orange yellow in life; dark oblique streaks continuous, not interrupted; interorbital space wide, 3.10 to 3.90 in head, but mostly 3.40 to 3.70 in head; second anal spine usually 2.40 to 2.80 in head; gill-rakers on first arch 22 to 27, long, the longest one 8.00 to 12.00 in head .....*N. mitsukurii*.
    cc. Upper jaw much longer than lower and overhanging beyond the latter when mouth is closed; preopercular margin armed with sharp serrations; body tinged with orange yellow in life; dark oblique streaks along rows of scales interrupted above lateral line; interorbital space narrower, varies 3.90 to 5.10 in head, but almost all of them 3.90 to 4.70 in head; second anal spine longer, mostly 1.90 to 2.40 in head; gill-rakers on first arch 16 to 23, but usually 16 to 21, shorter, the longest one 12.00 to 17.00 in head .....*N. albiflora*.
  bb. Soft dorsal rays 22 or 23; gill-rakers on first arch fewer than 13, very short, the longest one shorter than 1/4 the diameter of orbit; preopercular margin armed with sharp spinules .....*N. goma*.
aa. Second anal spine short and weak, always shorter than 1/4 the length of head; no dark oblique streaks on sides of body; preopercular margin crenulated or entire, but never spiniferous.
    d. Basal one-third of soft dorsal thickly scaly; dorsal spines usually 10

(first spines 9); the fish attains to an enormous size ..... ..... *N. imbricata*, nom nov.

dd. Soft dorsal naked, only one or two rows of scales running along its base; dorsal spines usually 11 (first dorsal 10).

e. Caudal short and double concave posteriorly; pectoral very short, much shorter than postorbital part of head; eye shorter than 1/9 the length of head; posterior margin of preopercle smooth; the fish attains to a large size ..... *N. japonica.*

ee. Caudal spatulated posteriorly; pectoral longer than postorbital part of head; eye longer than 1/6 the length of head; posterior margin of preopercle crenulate.

f. Mouth colorless; peritoneum dotted with small specks, but not black; lower jaw included below upper when mouth is closed; upper profile of head roundly convex; second anal spine as long as the diameter of orbit..... *N. argentata.*

ff. Mouth and peritoneum jet black; jaws equal or lower jaw somewhat longer than upper when mouth is closed; upper profile of head nearly straight; second anal spine usually shorter than diameter of orbit ..... *N. nibe.*

## *Nibea mitsukurii* (Jordan & Snyder)

Japanese name: *Nibe.*

*Corvina cuja* Temminck & Schlegel, 1843, p. 58 (Nagasaki), not *Bola cuja* Buchanan-Hamilton, a species from India.

*Pseudotolithus mitsukurii* Jordan & Snyder, 1900, p. 356, pl. 13 (Tôkyô).——Jordan & Snyder, 1901, p. 81 (Yokohama).——Smith & Pope, 1906, p. 478 (Kôti).——Franz, 1910, p. 45 (Yokohama).

*Sciaena mitsukurii* Jordan & Thompson, 1911, p. 246 (Tôkyô, Bôsyû, Matusima, Wakanoura)——Snyder, 1912, p. 416 (Tôkyô market).——Jordan & Thompson, 1914, p. 258 (Sendai).——Tanaka, 1916 b, p. 177, pl. 48, fig. 187, pl. 49, figs. 189-190 (Tôkyô market).——Ichijima, 1927, p. 6 (Toyama Bay).——Kamohara, 1931, p. 89 (Kôti).

*Sciaena albiflora* Regan, 1905, p. 20 (Inland Sea of Japan)——(pars) Jordan, Tanaka & Snyder, 1913, p. 178—— ? Matsuura, 1920, p. 147 (Takamatu)——Tanaka, 1930, p. 438 (Onahama, Hukuiken).

*Nibea mitsukurii* Jordan & Hubbs, 1925, p. 243 (Toba, Sizuoka, Tyôsi).—— Kuroda, 1931, p. 110 (Sizuura).

*Sciaena (Nibea) mitsukurii* (pars) Schmidt, 1931, p. 71 (Tôkyô market, Huzan).

*Johnius cujus* Fowler, 1933, p. 390 (Japan).

Snout rather short and blunt; upper jaw slightly longer than lower, but not overhanging beyond it when mouth is closed. Interorbital space very wide and flattish, always much wider than length of snout or diameter of orbit. Preopercular margin crenulate, but devoid of true spines. Second anal spine long and strong, but much shorter

than length of postorbital part of head and slightly shorter than length of snout measured from posterior end of orbit. At the base of second dorsal, only a single row of low scales arranged longitudinally and entirely naked all over; anal also devoid of scales. Gill-rakers long and slender, 22 to 27 on first arch, but mostly 23 to 26, the longest one on first arch 7.00 to 13.00 in head, but mostly 8.00 to 12.00 in head, and always much longer than half diameter of orbit. Color in life light grayish blue, paler and silvery below, always without yellow tint; dark streaks above lateral line not interrupted.

Fowler[19] synonymized this species with *Bola cuja* Buchanan-Hamilton 1822 [=*Nibea cuja* (Buchanan-Hamilton)], a species from India, but each one of these two is thought to be a distinct form by the following points, though I cannot gain access to the original description of the latter species:

1. The second anal spine of the latter species is much longer than the former. Günther[22] wrote on the latter species as: "The second anal spine exceedingly strong, as long as the first ray, and 3/4 of the length of head." Day[17,18] also commented on that species: "Second anal spine very strong, nearly or quite as long as first ray and equalling length of head behind middle of eye." On the other hand, 102 specimens of *Nibea mitsukurii*, measuring 121 to 275 mm in body-length, which I observed, have without exception second anal spine much shorter than postorbital part of head or half the length of head.

2. In the description of *Corvina cuja* (=*Nibea cuja*), Günther[22] notes: "The interspace between the eyes is rather narrower than horizontal diameter of eye." This character does not agree with that of *N. mitsukurii* in which the interorbital space is always much wider than length of snout or the diameter of orbit.

3. In the description of *Corvina cuja*, Günther[22] also states: "The second dorsal and anal scaly for one-third of their height." In Day's description[17,18] of *Sciaena cuja* (=*Nibea cuja*), he puts: "The basal third of the soft dorsal and anal densely scaled." But my 102 specimens of *N. mitsukurii* are all provided with only single row of very low scales along the base of second dorsal but not extending to basal third of it, and moreover, with the anal fin entirely naked.

Though Günther[22] and also Fowler[19] made *Johnius serratus* Schneider (1801) a synonym of *Bola cuja* of Buchanan-Hamilton with some doubt I cannot discuss the relationship of former species to *Bola*

*cuja* of BUCHANAN-HAMILTON and also to *N. mitsukurii* as I cannot gain access to the original description of *Johnius serratus* of SCHNEIDER.

But as DAY[17] identified *Sciaenoides asper* BLYTH (1860) as a young of BUCHANAN-HAMILTON's *Bola cuja*, I think that *N. mitsukurii* distinctly differs from the former one.

Examined 6 specimens each from Siogama and Tôkyô Bay, and 96 specimens from Miya (Aiti-Ken).

Distribution: Known from Matusima and Toyama Bay southward to Kôti and Nagasaki.

### *Nibea albiflora* (RICHARDSON)

Japanese Name: *Koiti*

*Corvina*? *albiflora* RICHARDSON, 1846, p. 226 (Canton).
*Sciaena ten-lo* BASILEWSKY, 1855, p. 220, pl. 1, fig. 3 (Gulf of Pechili, Peking).
*Pagrus macrocephalus* BASILEWSKY, 1855, p. 222, pl. 3, fig. 1 (Gulf of Pechili and Oriental Sea, Peking).
*Sciaena albiflora* GÜNTHER, 1860, p. 284 (China)——GÜNTHER, 1873, p. 378 (Cheefoo).——JORDAN & THOMPSON, 1911, p. 249, fig. 2 (Poat Arthur, Manchuria).——JORDAN & METZ, 1913, p. 36 (Port Arthur, Huzan, Tinnanpo).
*Corvina macrophthalmus* BLEEKER, 1873, p. 117 (China).
*Sciaena* (*Corvina*) *albiflora* STEINDACHNER, 1892, p. 361 (Shanghai).
*Pseudosciaena mitsukurii* JORDAN & STARKS, 1906, p. 520 (Port Arthur, Manchuria).
*Nibea albiflora* JORDAN & HUBBS, 1925, p. 243 (Hukuoka).——MORI & UCHIDA, 1934, p. 14 (Huzan, Zinsen, Tinnanpo).——LIN, 1935, p. 22 (Chusan, Shantung).
*Nibea mitsukurii* CHU, 1931, p. 247 (Shanghai).
*Sciaena* (*Nibea*) *mitsukurii* (pars) SCHMIDT, 1931, p. 71, (Huzan, Tôkyô market).

Snout rather long, upper jaw much longer than lower, and overhanging beyond it when mouth is closed. Interorbital space rather roundly convex, and laways narrower than length of snout, but wider than diameter of orbit. Preopercular margin armed with sharp minute spines. Second anal spine very long and strong, usually much longer than snout measured from posterior end of orbit, but shorter than postorbital part of head. Second dorsal fin only provided with a single row of very low scales at the basal part of it. Gill-rakers on first arch 16 to 23, but mostly 16 to 21, the longest on one first arch usually much shorter than half diameter of orbit and 11.00 to 18.00 in head, but almost all of them 12.00 to 17.00 in head. In life body deeply tinged with orange yellow, especially brightest at belly; dark oblique streaks along rows of scales continuous, not interrupted above lateral line.

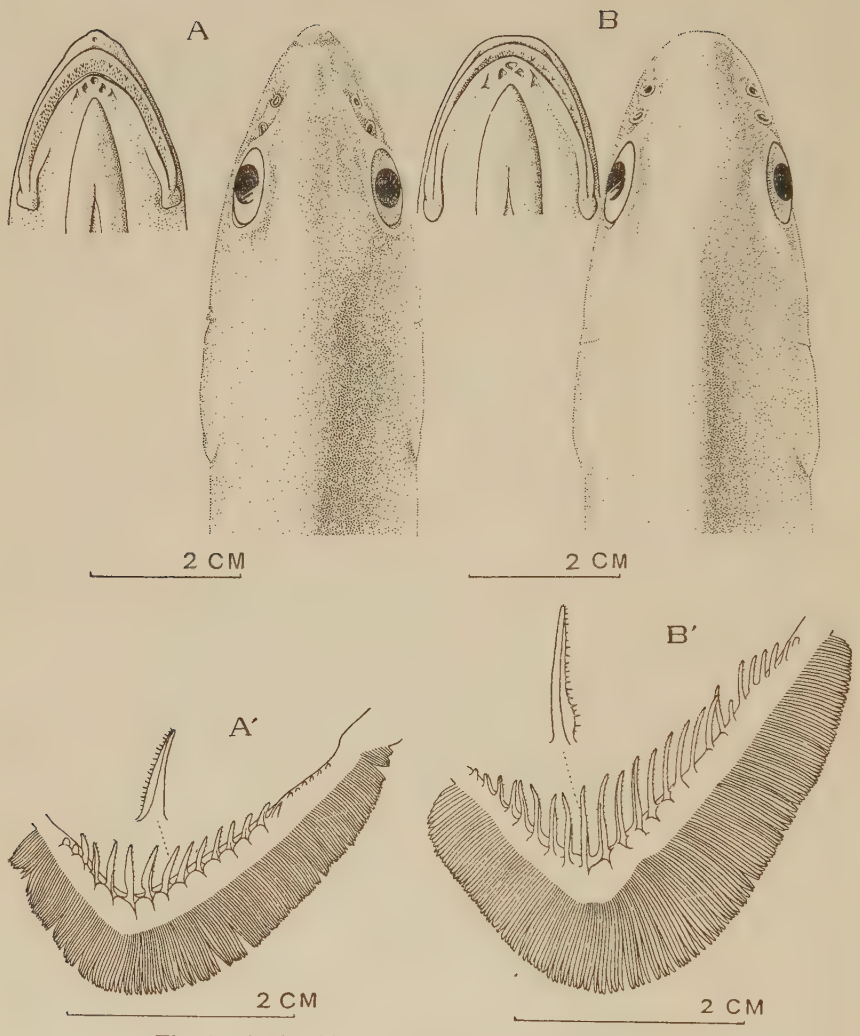


Fig. 1. A, A′, *Nibea albiflora* (RICHARDSON);
B, B′, *N. mitsukurii* (JORDAN & SNYDER).

The following items serve for separating this species from *Nibea mitsukurii* (See Figs. 1–7 and Tables 2 and 3).

1) *Width of interorbital space:* *N. albiflora* has a proportionally narrower interorbital space than *N. mitsukurii*, varying 3.90 to 5.10 in head and mostly 3.90 to 4.70 in 97 specimens of the former 154 to 362 mm in body length. In 102 specimens of *N. mitsukurii* measuring 121 to 275 mm in body length, the interorbital space varies

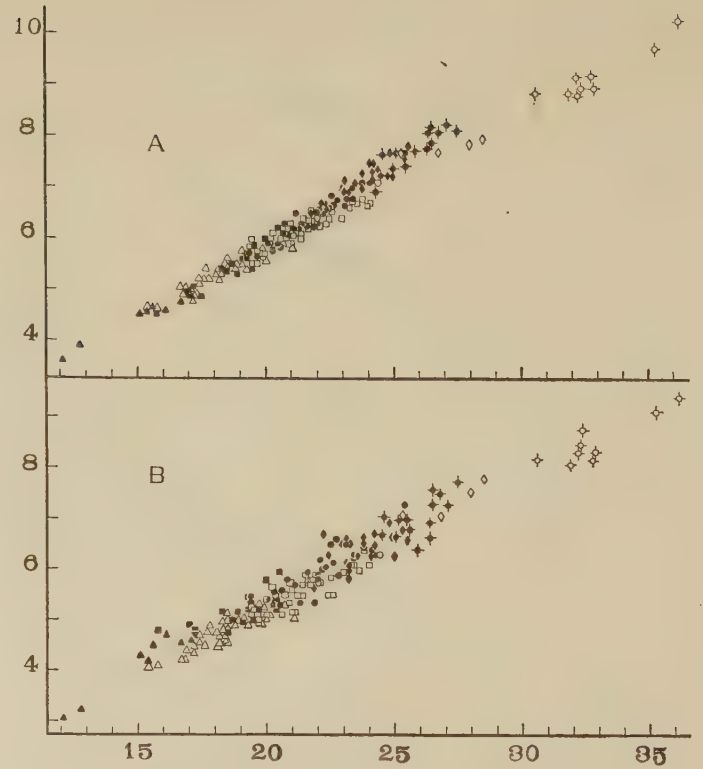


Fig. 2. Showing dimension (in cm) of body parts in relation to body length of *Nibea mitsukurii* and *N. albiflora*.
A, length of head; B, depth of body.
*N. mit.* △, one year old; □, two years; ○, three years; ◇, four years; ⊹, five years.
*N. alb.* ▲, one year old; ■, two years; ●, three yerrs; ◆, four years; ✦, five years.

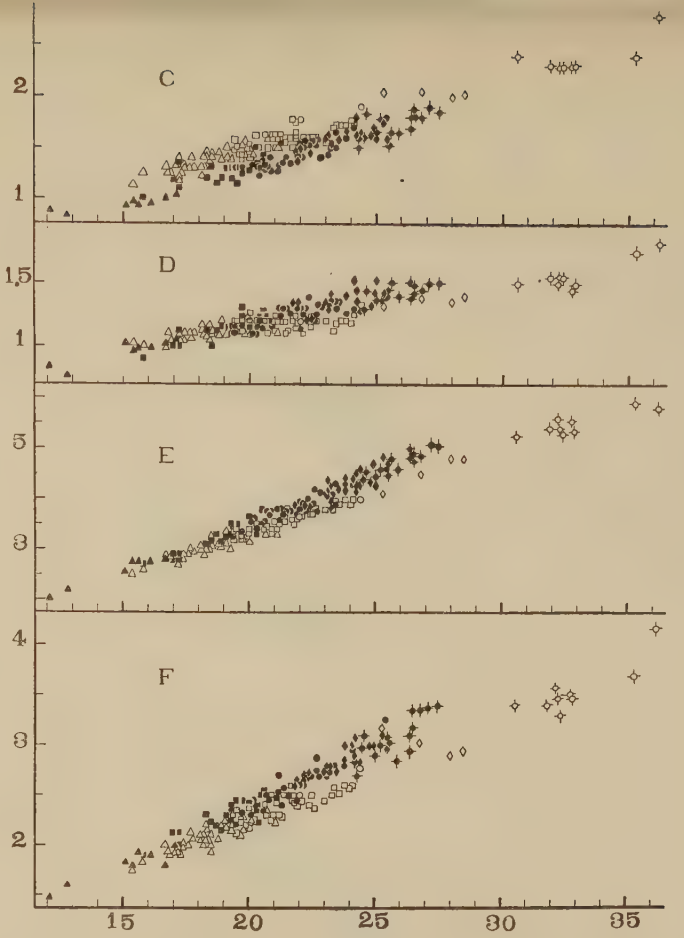


Fig. 3. Same as in Fig. 2 with the same yearly symbols.
C, length of snout; D, diameter of orbit;
E, length of postorbital part of head;
F, length of maxillary.

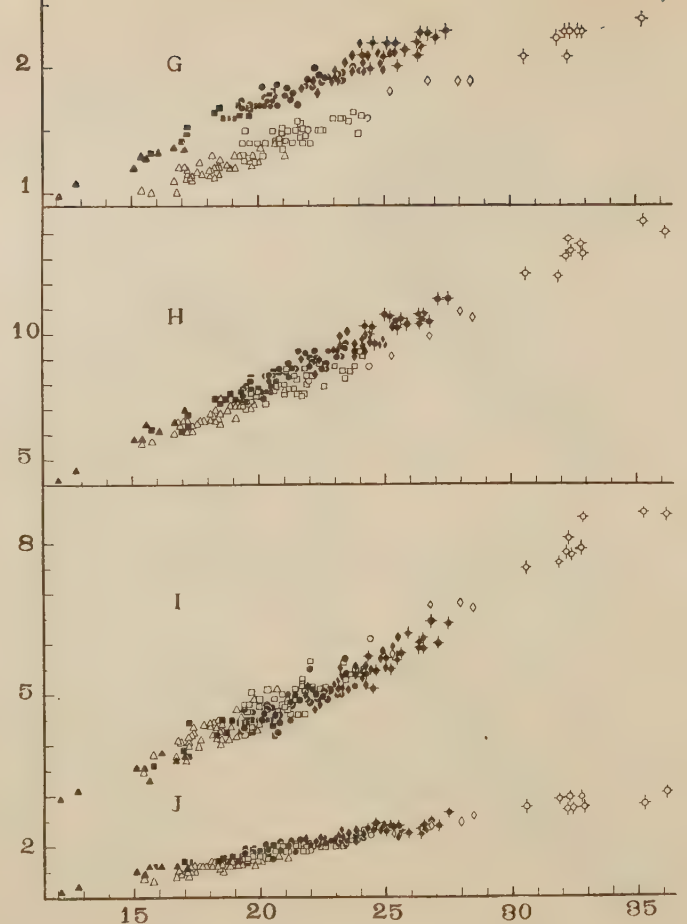


Fig. 4. Same as in Fig. 2 with the same yearly symbols.
G, width of interorbital space;
H, distance from origin of ventral to anal;
I, length of caudal peduncle;
J, depth of caudal peduncle.

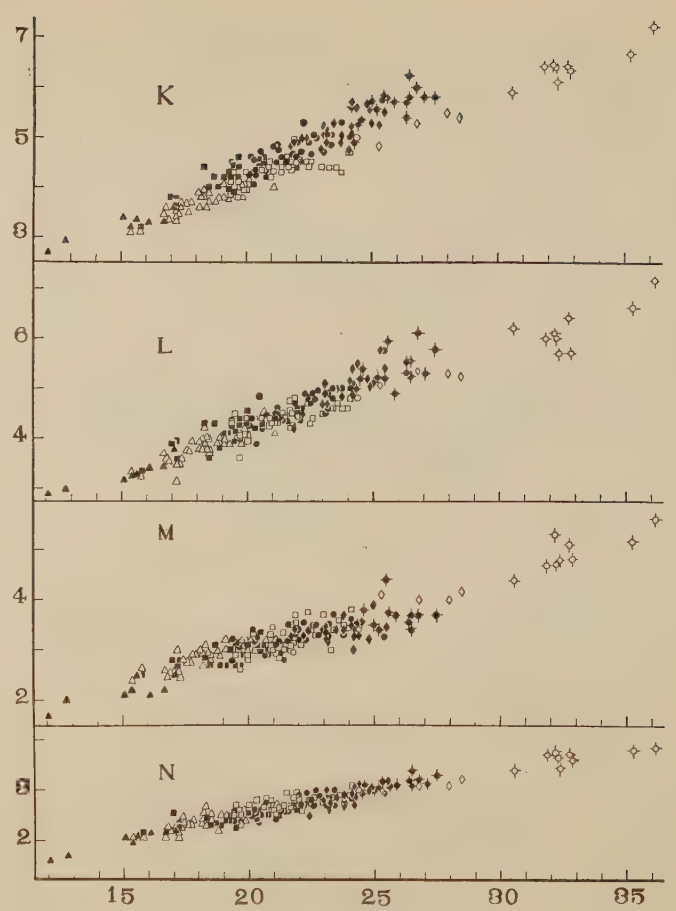


Fig. 5. Same as in Fig. 2 with the same yearly symbols.
K, length of pectoral;
L, length of ventral;
M, length of the longest dorsal spine;
N, length of the longest dorsal ray.

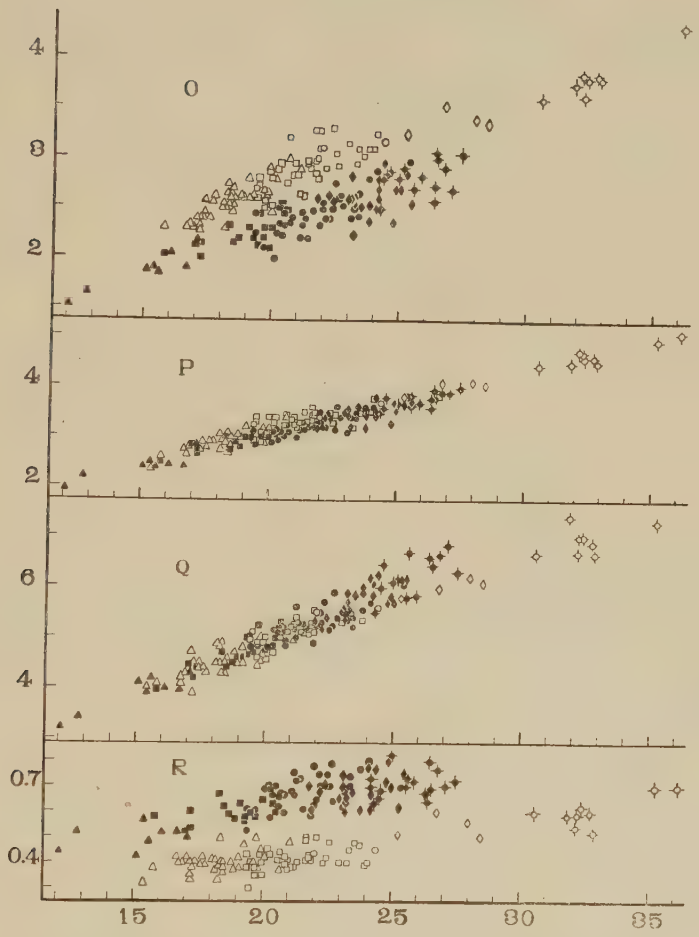


Fig. 6. Same as in Fig. 2 with the same yearly symbols.
O, length of second anal spine;
P, length of the longest anal ray;
Q, length of caudal fin;
R, length of the longest gill-raker on first arch.

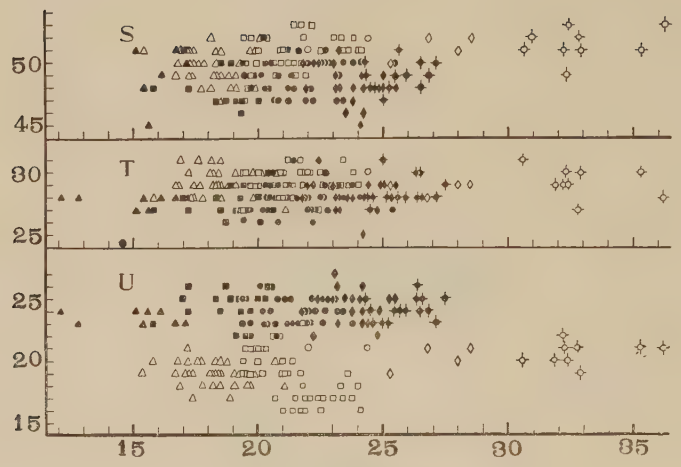


Fig. 7. Same as in Fig. 2 with same yearly symbols.
S, number of pored scales on lateral line;
T, number of soft dorsal rays;
U, number of gill-rakers on first arch.

3.10 to 3.90 in head, but mostly 3.40 to 3.70 in head.

2) *Length of second anal spine:* In *N. albiflora*, the second anal spine is proportionally longer than in *N. mitsukurii*, though not so distinctly as is the case with interorbital space. The former has usually the longest dorsal spine 1.90 to 2.40 in head, but the latter 2.40 to 2.80 in head.

3) *Length of gill-rakers:* *N. albiflora* has the shorter gill-rakers than *N. mitsukurii*, opposite is the case with the length of second anal spine. Almost all of 97 specimens of the former have the longest gill-raker on first arch 12.00 to 17.00 in head, but in the latter 8.00 to 12.00 in head.

4) *Number of gill-rakers on first arch:* *N. albiflora* has 16 to 23 and almost all of them 16 to 21, but the other is provided with 22 to 27 gill-rakers and mostly 23 to 26.

5) *Shape of jaws:* The upper jaw is much longer than lower jaw in *N. albiflora* and overhanging beyond it when the mouth is closed, but in *N. mitsukurii*, the jaws are nearly equal, the upper jaw does not project beyond the lower one when the mouth is closed.

6) Preopercular margin is armed with sharp serrations in *N. albiflora*, but crenulate and devoid of true spine in *N. mitsukurii*.

7) *Color in life:* Body is tinged with orange yellow, especially

brightest at the belly in *N. albiflora*, but uniformly silvery in the other.

8) *Markings:* The dark oblique streaks along the rows of scales are interrupted above lateral line in *N. albiflora*, but continuous in the other.

Examined specimens are 97 ones from Huzan.

Distribution: Coasts of China to Simonoseki and soutbern parts of Tyôsen.

### *Nibea goma* (Tanaka)

Japanese name: *Goma-nibe.*

*Sciaena goma* Tanaka, 1915, p. 615 (Nagasaki).——Tanaka, 1916 C, p. 392, pl. 107, fig. 327 (Nagasaki).
*Johnius goma* Fowler, 1933, p. 327 (Nagasaki).
*Nibea goma* Lin, 1935, p. 15, fig. 15 (Shantung, Chusan Islands).

Snout rather long, conical, pointed at tip; upper jaw overhanging beyond the lower when mouth is closed; maxillary extends below posterior end of pupil or orbit. Eye very small, its diameter much shorter than length of snout or width of interorbital space; interorbital space slightly convex, much narrower than length of snout. Preopercular margin armed with sharp serrations. Soft anal rays 22 or 23, fewer than allied species; dorsal spines always 11. Second anal spine rather long and strong, about 1/3 the length of head and longer than length of snout or 1/2 the length of postobital part of head. Caudal spatulated. Two rows of small scales arranged irregularly at base of soft dorsal, otherwise entirely naked; anal devoid of scales. Gill-rakers very few, 13 or 14 on first arch, very short, the longest one 5.0 to 5.25 times in orbit and 29.00 to 32.00 in head.

Ground color in formalin uniformly dark gray, irregular dark spots spreading upward and backward along the rows of scales, distinct above lateral line, becoming indistinct downward and forward; pectoral, ventral and anal black; dorsal and caudal dark gray, scattered with irregular black spots.

Two specimens obtained from China Sea, their dimensions are as follows:

Table I.

| | | |
|---|---|---|
| Sex | ? | ? |
| Total length (mm) | 259.5 | 248.0 |
| Body length (mm) | 205.0 | 202.0 |
| Scales | 54 | 52 |
| Dorsal | X–I, 22 | X–I, 23 |
| Anal | II, 7 | II, 7 |
| Pectoral | 19 | 19 |
| Gill-rakers | 14 | 3 |
| Vertebræ | 25 | 25 |
| Head in body length | 3.20 | 3.18 |
| Depth in body length | 3.83 | 3.88 |
| Distance from origin of ventral to anal in body length | 2.69 | 2.69 |
| Orbit in head | 5.82 | 6.05 |
| Snout in head | 3.79 | 3.74 |
| Maxillary in head | 2.43 | 2.40 |
| Interorbital space in head | 4.67 | 4.64 |
| Postorbital part of head in head | 1.68 | 1.67 |
| Length of caudal peduncle in head | 1.43 | 1.40 |
| Depth of caudal peduncle in head | 3.20 | 3.34 |
| Pectoral in head | 1.45 | 1.59 |
| Longest dorsal spine in head | 2.21 | — |
| Longest dorsal ray in head | 2.12 | 2.20 |
| Second anal spine in head | 3.06 | 3.04 |
| Longest anal ray in head | 2.00 | 2.06 |
| Ventral in head | 1.80 | 1.79 |
| Caudal in head | 1.08 | 1.14 |
| Longest gill-raker in head | 29.09 | 31.75 |

The present species closely resembles *N. albiflora*, but differs from it in having shorter gill-rakers, and much fewer soft dorsal as well as gill-rakers on first arch.

Habitat: Nagasaki and China Sea.

### ***Nibea imbricata***, nom nov.

New Japanese name: *Honnibe*.

? *Sciaena mi-iuy* BASILEWSKY, 1855, p. 22 (Mari Meridiano, Peking).
*Sciaena japonica* JORDAN & METZ (not of TEMMINCK & SCHLEGEL, 1843), 1913, p. 35, pl. 7, fig. 1 (Tinnanpo, Huzan, Seoul).
*Nibea japonica* JORDAN & HUBBS, 1925, p. 244 (Tôkyô market, Sizuoka).
*Sciaena* (*Nibea*) *japonica* SCHMIDT, 1931, p. 72 (Huzan).
*Corvina japonica* LIN, 1935, p. 11, fig. 6 (Shantung).

Head 3.54 in body length; depth 5.03; distance from origin of ventral to anal 2.49.

Orbit 5.52 in head; snout 4.64; maxillary 2.34; interorbital space 4.96; postorbital part of head 1.60; length of caudal peduncle 1.26; depth of caudal peduncle 3.77; pectoral 1.46; longest dorsal spine (fourth one) 2.57; longest dorsal ray 2.89; second anal spine 4.37; longest anal ray 2.54; ventral 2.00; caudal 1.25.

D. IX–1, 28; A. II, 7; P. 22; branchiostegal rays 7; pored scales 55 on lateral line, 15 from origin of dorsal to lateral line, 25 from lateral line to origin of anal; gill-rakers on first arch 7+9=16, rather short and stout, the longest one 2.70 times in diameter of orbit and 14.82 times in head.

Body greatly elongate and tapering behind. Dorsal profile of body not greatly arched; ventral outline less curved than dorsal one. Snout short and blunt, about 1.20 times of horizontal diameter of orbit. Mouth large, oblique, lower jaw slightly shorter than upper, but not included when mouth is closed; maxillary extends below posterior end of orbit; lips thick, fringed along edge, outer teeth of upper jaw and inner ones of lower jaw very large and strong, and somewhat canine-like. Chin with four pores at symphysis. Preopercular margin crenulate, but without bony serræ. Eye large and ovate, its horizontal diameter slightly shorter than interorbital space which is somewhat roundly convex.

Dorsal fin beginning above end of base of ventral, with a deep notch between spinous and soft parts; dorsal spines rather weak, fourth one the longest, but shorter than maxillary; basal one-third of soft dorsal and base of anal covered with small scales. Second anal spine slender and weak, somewhat longer than diameter of orbit or one-third the length of postorbital part of head. Caudal longer and spatulated, not double concave posteriorly. Pectoral long, longer than postorbital part of head or length of ventral; axil of pectoral with a large scaly dermal flap. Ventral naked.

Body covered with rather small ctenoid scales except jaws, throat and branchiostegal membrane.

Vertebræ 24+hypural=25.

Color in formalin dark brown throughout, but somewhat paler below; fins also dark brown; a row of dark spots running along middle of soft dorsal. Mouth colorless, branchial cavities gray; peritoneum spotted with black pigments, but not black.

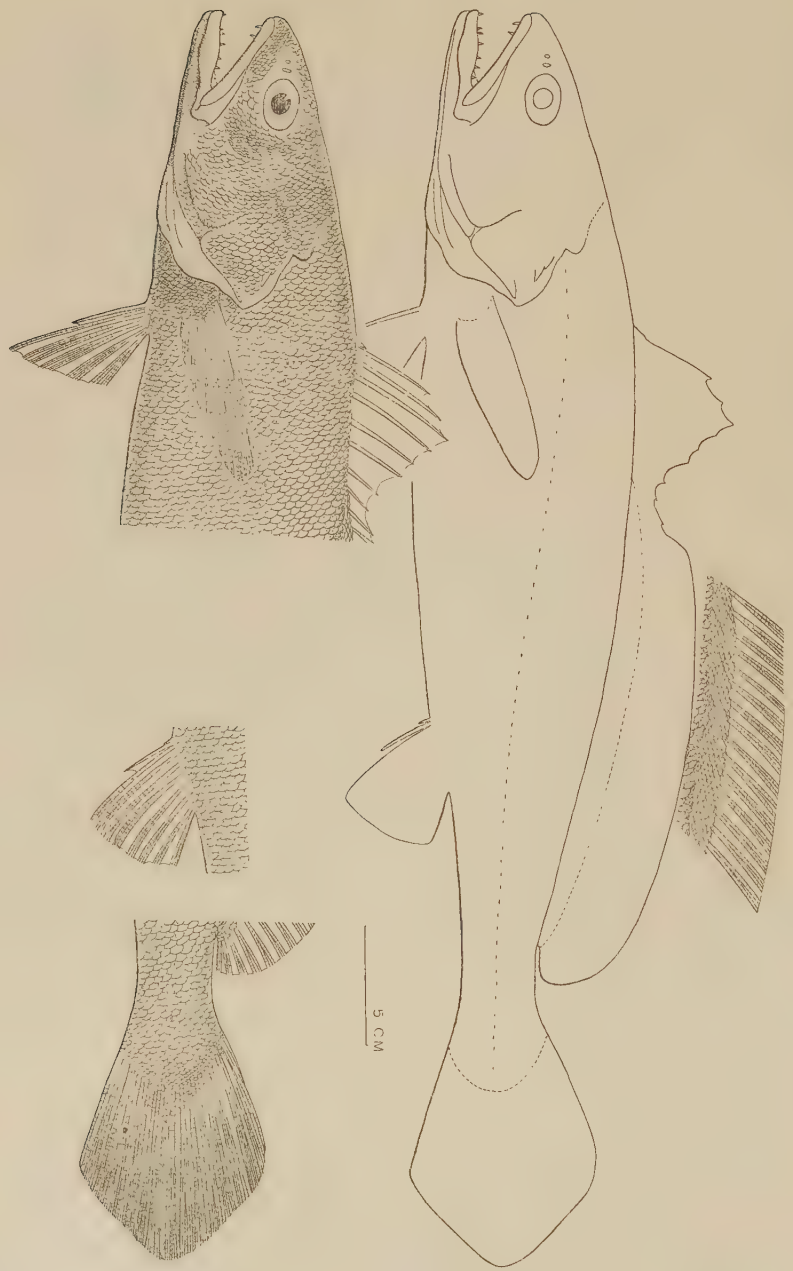


Fig. 8. *Nibea imbricata*, nom. nov.

Described and figured from a male specimen, Imp. Fish. Inst. Fish Spec. No. 3512, measuring 519 mm long (body length 430 mm), obtained from China Sea.

The dimensions of other 13 specimens obtained from China Sea are shown in table 4.

Differs from TEMMINCK et SCHLEGEL's *Sciaena japonica* at least in having the spatulated caudal, much larger eye, longer pectoral and the basal one-third of soft dorsal thickly covered with small scales.

The present species resembles one of Basilewsky's[(2)] *Sciaena mi-iuy** in having 9 first dorsal spines, spatulated caudal and elongated body and gray in coloration, but I cannot find any other important agreements between them, and moreover, the characters noted above also agree with one of other sciaenoid fishes.

The present species resembles in general form *Otolithus biauritius* of CANTOR[(18,74)] and *O. brunneus* of DAY,[(18,74)] but differs from the former at least in having only one pore on tip of snout (five in *O. biauritius*) and larger eye, nearly as long as the width of interorbital space (smaller and about twice in interorbital space in *O. biauritius*). Differs from the latter also in having one pore on tip of snout (absent in the latter species) and longer second anal spine, somewhat longer than half length of the longest anal ray (in the latter, the second anal spine very short, one-third as long as the longest anal ray).

Examination has been made on 14 specimens from China Sea.

Habitat: The present species is very common in southern part of Tyôsen and China Sea, but it does not seem to range to the coast of Japan.

### *Nibea japonica* (TEMMINCK & SCHLEGEL)

Japanese name: *Ônibe*

*Sciaena japonica* TEMMINCK & SCHLEGEL, 1833, p. 58, pl. 24, fig. 1 (Southeast coast of Japan).

Head 3.52 in body length; depth 4.15; distance from origin of ventral to anal 2.76.

* The following is the original description of *Sciaena mi-iuy* BASILEWSKY: Operculum branchiale robustum, magnum, fibrosum. Dentes canini robusti. Corpus elongatum, griseum. Squamis magnis obtectum. Pinne dorsalis pars acanthopterigia 9-radiata; pectorales oblongæ radius duriusculis; abdominales duobus radius osseis; caudalis elongata, spatulata; analis duobus radiiscostatis. Habitat in Mari Meridino. Inpiscariis (Chinensibus Muyu). Longit. 2 pedes et 1 poll. Latit. 51/2 poll.

Orbit 9.44 in head; snout 3.76; maxillary 2.59; interorbital space 4.50; postorbital part of head 1.59; length of caudal peduncle 1.08; depth of caudal peduncle 3.58; pectoral 1.84; longest dorsal spine (third one) 2.59; longest dorsal ray 3.33; second anal spine 4.61; longest anal ray 2.53; ventral 1.91; caudal 1.69.

D. X–I, 27; A. II, 6; P. 16; branchiostegal rays 7; pored scales 50 on lateral line, 13 from origin of dorsal to lateral line, 19 from lateral line to origin of anal; gill-rakers on first arch (including rudiments) 6+13=19, short and stout, the longest one 1.80 times in horizontal diameter of orbit.

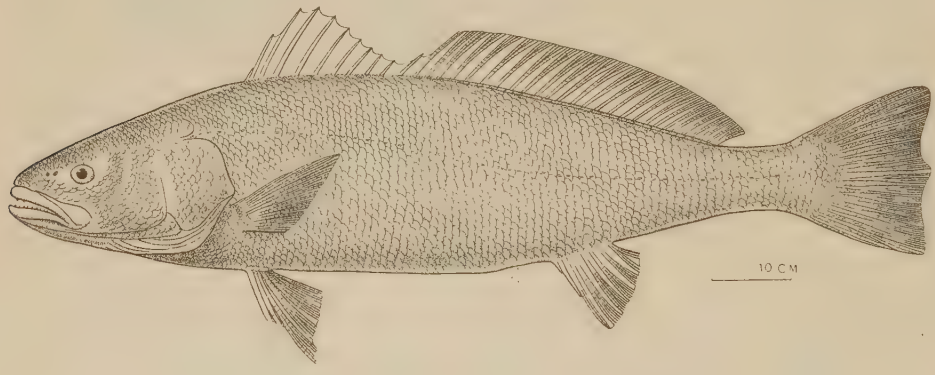


Fig. 9. *Nibea japonica* (TEMMINCK & SCHLGEL).

Body elongate and much compressed. Dorsal outline of body gradually and evenly arched, the profile of head nearly straight from tip of snout to origin of dorsal; ventral contour less arched than as in dorsal. Snout very long, bluntly pointed, 2.50 times of horizontal diameter of orbit which is very small. Mouth large, lower jaw slightly longer than upper; cleft of mouth oblique, maxillary extends below posterior end of pupil. Lips thick, fringed along edge. Teeth on lower jaw strong, sharp, 17 on

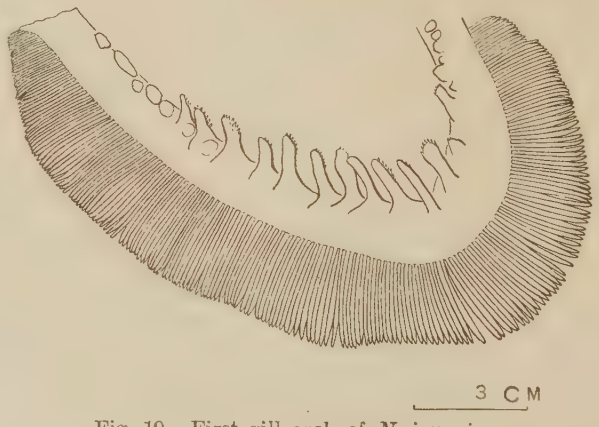


Fig. 10. First gill arch of *N. japonica*.

each side of mandible, arranged in one row and several smaller conical teeth scattered between them, no outer villiform teeth; teeth of upper jaw villiform, the outer series enlarged; vomer and palatines edentate. Chin with four pores at symphysis and a slit-like one behind them on each side; no barbels at chin. Preopercular margin smooth, not ctenate nor serrated. Opercle ending in a single point. Subopercle and interopercle with many fine ridges directed outward. Orbit very small, shorter than one-half the width of interorbital space which is very wide and strongly convex.

Dorsal fin beginning above origin of ventral and somewhat behind base of pectoral, with a deep notch between spinous and soft portions; dorsal spines strong, third one as long as maxillary (upper jaw); basal part of soft dorsal with a row of very small and low scales embeded in the skin, but the rest of dorsal entirely naked. Anal naked, commences under middle of soft dorsal base; anal spines rather strong, the second one about 1/3 the length of postorbital part of head. Caudal short, double concave posteriorly. Pectoral very short, much shorter than postorbital part of head; axil of pectoral with a large dermal naked flap. Ventral naked, somewhat shorter than pectoral.

Body covered with fine ctenoid scales except jaws, throat, branchiostegal membranes and greater parts of fins.

Vertebræ 24+hypural=25

Color in life brownish gray above, paler and slivery below; fins light gray, distal half of soft dorsal and caudal darker. Mouth and branchial cavity dark gray. Perintoneum silvery white.

The above description and figures are drawn from a female specimen, Imp. Fish. Inst. Fish Spec. No. 3513, measuring 1173 mm long (body length 1013 mm), obtained off Bôsyû, near Tôkyô.

My specimen agrees with one of *Sciaena japonica* of Temminck & Schlegel[73] except longer head and fewer anal fin rays, but quite differs from the one identified as Temminck & Schlegels' *Sciaena japonica* by all other authors in having the following important characters:

1) Caudal very short and double concave posteriorly, not lanceolated; 2) lower jaw longer than upper; 3) pectoral very short, much shorter than postorbital part of head; 4) eye very small, shorter than one-nineth of the length of head; 5) snout very long, more than twice as long as the diameter of orbit; 6) subopercle and interopercle with many

fine ridges directed outward; 7) basal part of anal and basal one-third of soft dorsal not covered with scales; 8) preopercle not ctenate nor serrated; 9) axial flap of pectoral naked; 10) peritoneum silvery white, not gray; 11) lower jaw without band of villiform teeth.

### *Nibea argentata* (HOUTTUYN)

Japanese names: *Guti, Isimoti, Siroguti.*

*Sparus argentatus* HOUTTUYN, 1782, p. 320 (Nagasaki)

*Corvina argentata* CUVIER & VALENCIENNES, 1830, p. 144 (On Houttuyn).

*Corvina sina* CUVIER & VALENCIENNES, 1830, p. 122 (Pondichthys, Malbar, Japan). ——TEMMINCK & SCHLEGEL, 1843, p. 58, pl. 24, fig. 2 (Japan).——RICHARDSON, 1846, p. 225 (China).——BLEEKER, 1853, p. 36 (Japan).——BLEEKER, 1857, p. 82 (Nagasaki).——BLEEKER, 1857-58, p. 5 (Japan).——BLEEKER, 1869, p. 238 (Jedo). ——NYSTRÖM, 1887, p. 29 (Nagasaki).

*Sciæna sina* GÜNTHER, 1860, p. 292 (compiled).——DAY, 1878-88, p. 186, pl. 4, fig. 2 (Bombay, Sind).——GÜNTHER, 1880, p. 66 (Inland Sea of Japan).——DAY, 1889, p. 114 (India).——BOULENGER, 1892, p. 135 (Muscat).

*Sciaena bleekeri* DAY, 1878-88, p. 185, pl. 45, fig. 4 (Bombay, Gwadur).——DAY, 1889, p. 112 (India)——LLOYD, 1907, p. 225 (Akyab).

*Pseudosciaena schlegeli* BLEEKER, 1879, p. 9 (Nagasaki).

*Sciaena* (*Pseudosciaena*) *schlegeli* STEINDACHNER & DÖDERLEIN, 1883, p. 33 (Tôkyô).

*Sciaena bleekeri* STEINDACHNER & DÖDERLEIN, 1883, p. 33 (Japan).

*Corvina yeddoensis* STEINDACHNER & DÖDERLEIN, 1883, p. 35 (Jedo).

*Sciaena* (*Pseudosciæna*) *schleglii* STEINDACHNER, 1896, p. 208 (Japan).

*Corvula schlegeli* JORDAN & SNYDER, 1900, p. 356 (Tôkyô).——JORDAN & SNYDER, 1901, p. 81 (Yokohama, Nagasaki).——Franz, 1910, p. 45 (Yokohama, Dusi).

*Corvula argentata* JORDAN & EVERMANN, 1903, p. 351 (Formosa).——SMITH & POPE, 1906 (Kôti).

*Sciæna argentata* JORDAN & THOMPSON, 1911, p. 252 (copied).——MATSUURA 1920, p. 147 (Kii).——TANAKA, 1928, p. 180, fig. 491 (Tôkyô).

*Sciæna schlegeli* JORDAN & THOMPSON, 1911, p. 254 (Tôkyô, Onomiti, Turuga, Naoetu, Hirosima, Kawatana, Nagasaki).——SNYDER, 1912, p. 416 (Kagosima). ——JORDAN & METZ, 1913, p. 37 (Huzan).——JORDAN & THOMPSON, 1914, p. 254 (Matusima Bay, Ôsaka).——ICHIJIMA, 1927, p. 6 (Toyama Bay.)——KAMOHARA, 1930, p. 89 (Kôti).——TANAKA, 1930, p. 438 (Onahama, Hukui-ken).——TANAKA, 1931, p. 29 (Southern Japan area).——NAKAMURA, 1934. p. 11 (Toyama-ken).—— KOIKE, 1936, p. 10 (Hukui-ken).

*Sciæna iharæ* JORDAN & METZ, 1913, p. 37, pl. 7, fig 2 (Huzan).

*Johnius sina* FOWLER, 1933, p. 388 (Arabia, Portuguese East Africa, South Africa, Mekuran, Omen, India, East Indies, Philippines, China, Japan).——HARDENBERG, 1934, p. 309 (Rokan Mouth).

*Nibea schlegeli* JORDAN & HUBBS, 1925, p. 243 (Sizuoka, Ôsaka, Tôkyô, Kôbe, Mikawa Bay, Misaki, Hukuoka, Hukui, Miyazu).——SCHMIDT & LINDBERG, 1930, p. 1140 (Turuga).——MORI & UCHIDA, 1934, p. 14 (Huzan, Moppo, Jinsen, Tinnanpo).——INOUYE & SIMIZU, 1936, p. 10 (Inland Sea of Hyôgo-ken).

*Sciæna* (*Argyrosomus*) *schlegeli* Schmidt, 1931, p. 71 (Huzan).
*Sciaæna* (*Nibea*) *yeddoensis* Schmidt, 1931, p. 72 (Nagasaki).
*Johnius argentatus* Fowler, 1933, p. 394 (India, China, Korea, Japan)
*Nibea iharæ* Mori & Uchida, 1934, p. 14 (Huzan, Jinsen).
*Nibea argentata* Lin, 1935, p. 17 (Shangtung).
*Nibea sina* Lin, 1935, p. 20 (Chusan Islands, Chekiang Province)

Snout rather short and blunt, nearly as long as or slightly longer than interorbital space. Lower jaw somewhat included when mouth is closed. Upper profile of head gradually but evenly convex. Diameter of orbit usually shorter than interorbital space which is rather roundly convex. Preopercular margin crenulate, but without bony serrae. Second anal spine short and weak, usually subequal to the diameter of orbit. Soft dorsal rays 23 to 30, but most of them 24 to 28. Pored scales on lateral ine 43 to 52, but mostly 44 to 51; at the base of soft dorsal, only a single row of very small scales arranged longitudinally, and entirely naked elsewhere; anal naked. Gill-rakers on first arch 13 to 19, but mostly 14 to 18, the longest one of them 9.00 to 15.00 in head and usually shorter than half diameter of orbit. In life, the body light grayish brown above, paler below, never tinged with orange yellow, nor with remarkable markings except a large dark blotch on operculum. Distal and basal parts of soft dorsal darkened, leaving a clear stripe midway between them. Mouth colorless; peritneum dotted with small black specks, but not black.

My specimens are identical with one of *Sparus argentatus* of Houttuyn[30] (procured at Nagasaki), after the following Houttuyn's description translated by Jordan & Thompson:[42] "....dark blotch behind the opercle. Of the dorsal fin the 9 first rays are spiny, the 26 soft." Among the Japanese sciaenoid fishes belonging to the genus *Nibea*, *N. mitsukurii* and *N. japonica* are not identical with Houttuyn's *S. argentatus* at least in having no remarkable blotch on opercle, and again, *N. nibe* and *N. goma* are also distinct from Houttuyn's *S. argentatus* in having usually more than 29 soft dorsal rays in the former, and 22 or 23 soft dorsal rays in the latter.

In Figs. 11–15 are plotted 253 specimens (128 from China Sea, 59 from Simabara, 63 from Miya, 2 from Huzan and 1 from Siogama) of *N. argentata* in regard to a number of characters. It is obvious that at least these specimens belong to one category and cannot be divided into several species as described by many writers. But, as shown in Figs. 16 and 17 and table 5, the number of soft dorsal rays and pored

scales on lateral line seem to show an increase from Miya to China Sea. FOWLER[20] and LIN[47] distinguished *N. sina* from *N. argentata* by the difference in number of soft dorsal rays (27 to 29 rays in *N. sina* and 24 to 26 in *N. argentata*), but it is obvious that the definitions do not serve for distinction between two species noted above. (See figs. 11 to 15)

Again, the length of head seems to be proportionally shorter in China Sea specimens, longer in Miya, and Simabara specimens indicate

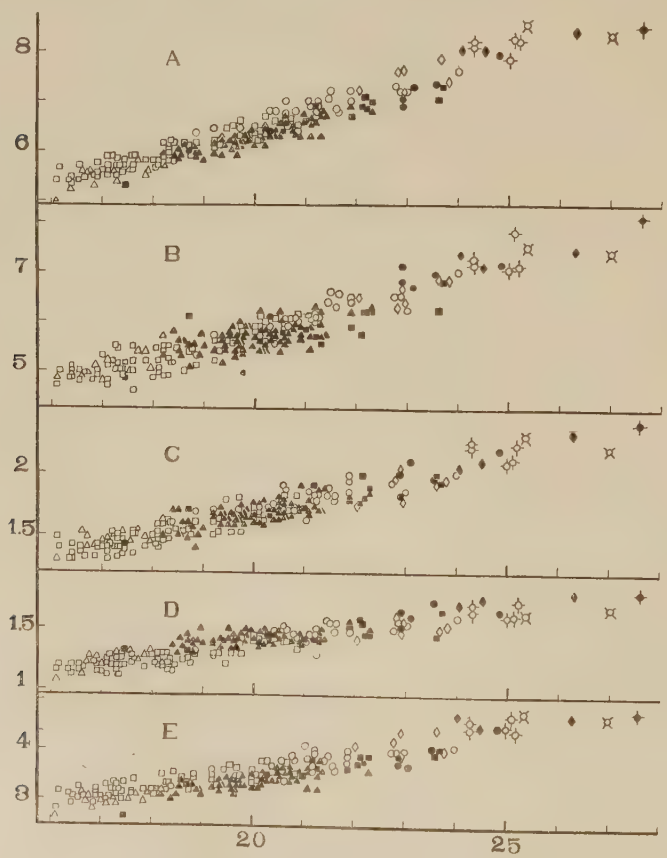


Fig. 11. Showing dimension (in cm) of body parts in relation to body length of *N. argentata*. A, length of head; B, depth of body; C, length of snout; D, diameter of orbit; E, length of postorbital part of head. △, one year old; □, two years; ○, three years; ◇, four years; ⊹, five years; ⊠, six years (White marks indicate the Japanese and Tyôsen specimens and solid ones show the China specimens)

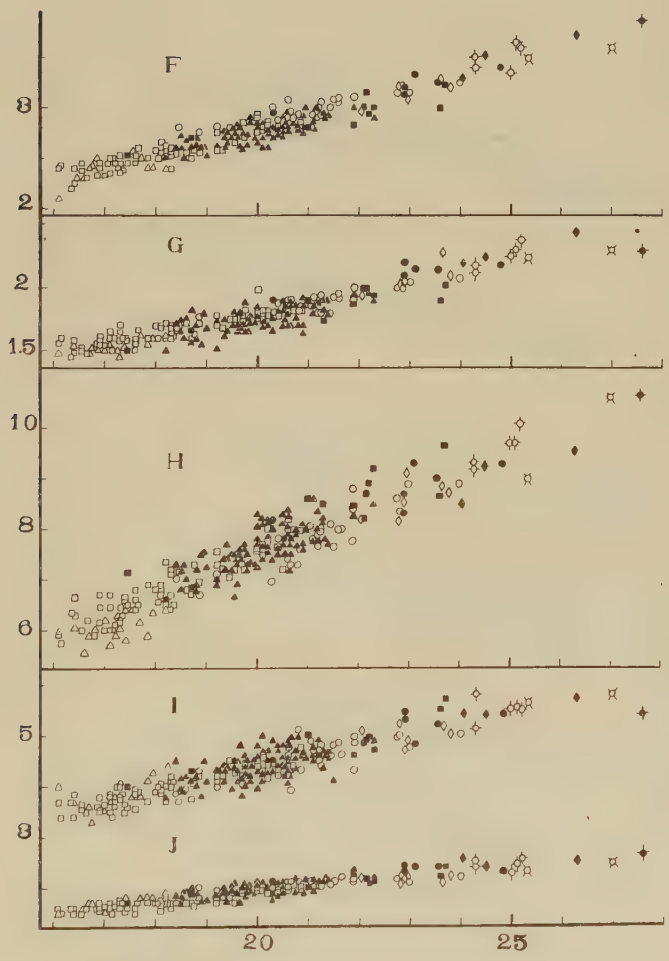


Fig. 12. Same as in Fig. 11 with the same yearly symbols. F, length of maxillary; G, width of interorbital space; H, Distance from origin of ventral to anal; I, length of caudal peduncle; J, depth of caudal peduncle.

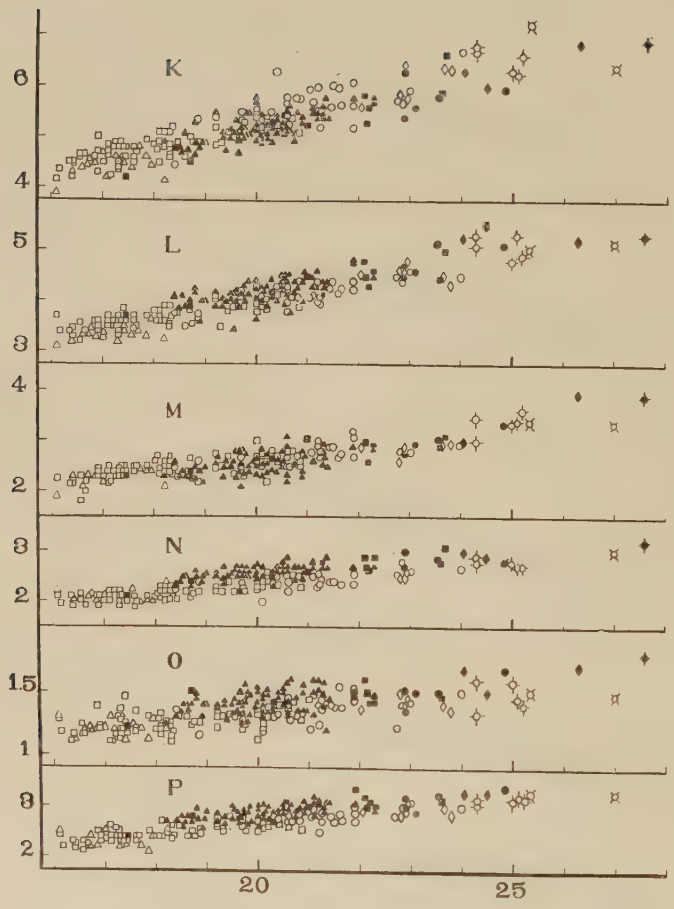


Fig. 13. Same as in Fig. 11 with the same yearly symbols. K, length of pectoral; L, length of ventral; M, length of the longest dorsal spine; N, length of the longest dorsal ray; O, length of second anal spine; P, length of the longest anal ray.

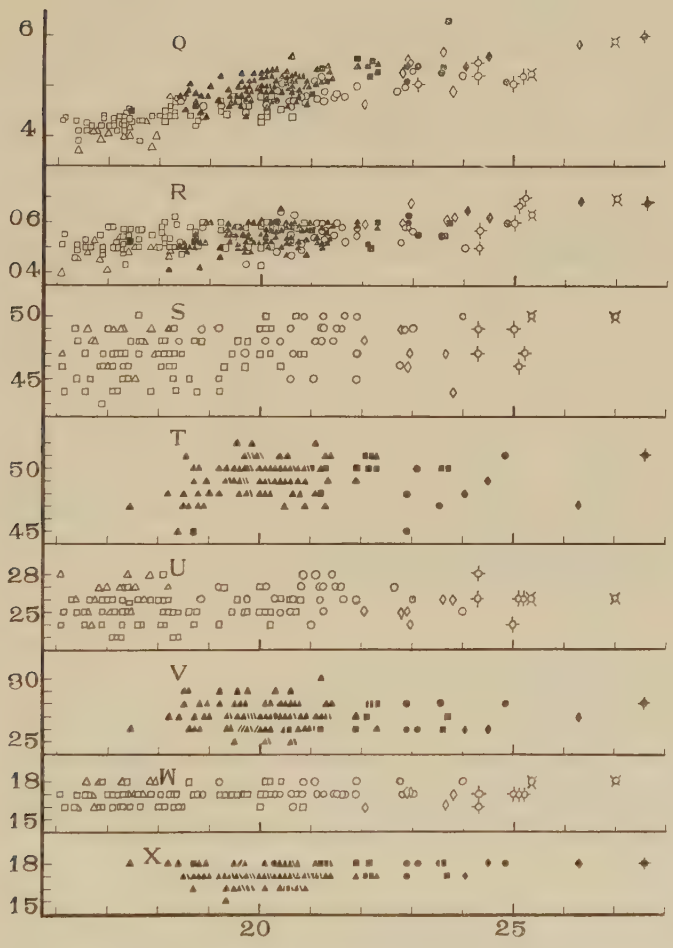


Fig. 14. Same as in Fig. 11 with same yearly symbols. Q, length of caudal fin ; R, length of the longest gill-raker on first arch ; S, T, number of pored scales on lateral line ; U, V, number of soft dorsal rays ; W, X, number of pectoral rays.

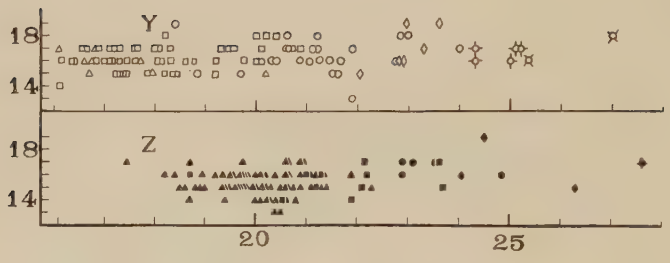


Fig. 15. Same as in Fig. 11 with same yearly symbols. Y, Z, number of gill-rakers on first arch.

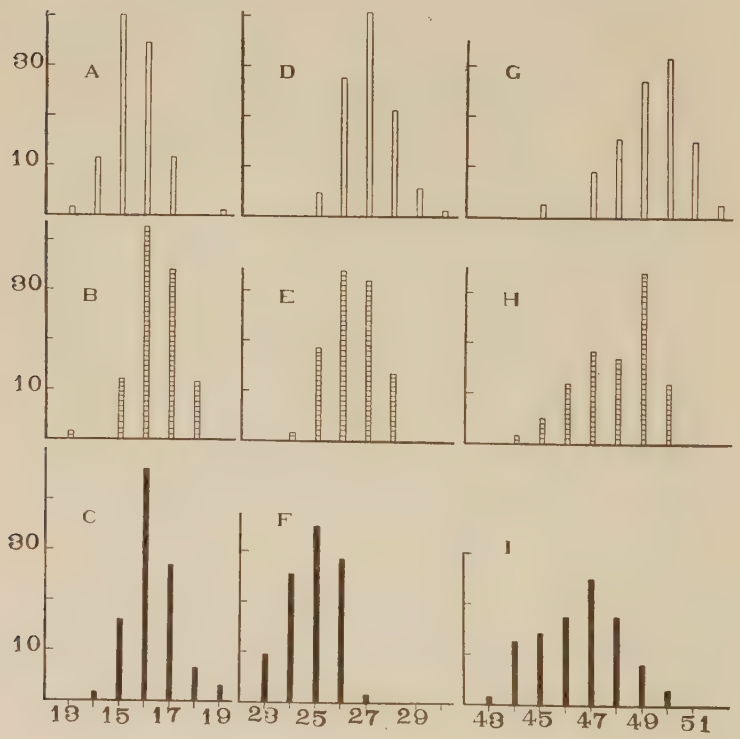


Fig. 16. Frequencies (in %) of number of gill-rakers on first arch (left side), soft dorsal rays (middle) and pored scales on lateral line in *N. argentata*. A, D, G, China Sea; B, E, H, Simabara; C, F, I, Miya (Aiti-Ken).

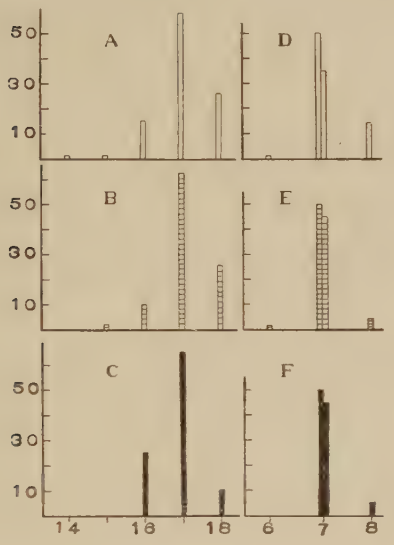


Fig. 17. Frequencies (in %) of number of pectoral rays (left side) and soft anal rays (right side) in *N. argentata*. A, D, China Sea; B, E, Simabara; C, F, Miya (Aiti-Ken).

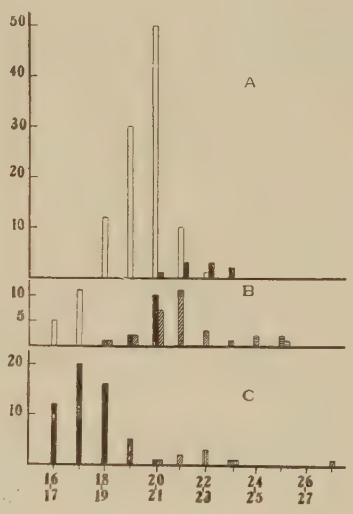


Fig. 18. Frequencies of body length (in cm) in relation to the age of *N. argentata*. A, China Sea (obtained Nov., 1936); B, Simabara (Aug., 1936); C, Miya (Jul., 1933). □, one year old; ■, two years; ▨, three years; ▥, four years; ▤, five years; ⊞, six years.

just intermediate form between them (Table 5); snout, diameter of orbit, length of maxillary, length of caudal peduncle, depth of caudal peduncle and the length of the longest dorsal ray show an increase in length proportional from Miya to China Sea, opposite is the case with the head length. But these local differences do not serve for separating this species into several species (Figs. 11 to 15).

Further, in comparing the same age specimens, the length of body of southern specimens is much longer than that of the northern ones (See Fig. 18), though the date and the number of specimens are different in each one of three localities as indicated in Fig. 18.

Although there are some remarkable morphological differences among the fish of three localities as noted above, I think that these differences do not indicate a specific distinction, but variations of local groups.

Examined 128 specimens from China Sea, 59 from Simabara, 63 from Miya, 2 from Huzan and 1 from Siogama.

Distribution: Widely distributed from Northern Japan and Tyosen to Indian Ocean.

### *Nibea nibe* (Jordan & Thompson)

Japanese names: *Hama-nibe, Kuroguti.*

*Sciæna nibe* Jordan & Thompson, 1911, p. 258, fig. 4 (Wakanoura).
*Nibea nibe* Jordan & Hubbs, 1925, p. 243 (Ôsaka market, Mikawa Bay).——Lin, 1935, p. 19, fig. 10 (Chusan).

Snout short and bluntly pointed, as long as or longer than interorbital space. Jaws equal or lower jaw very slightly longer than upper; teeth in two rows on both jaws, the outer teeth in upper jaw and inner ones in lower jaw much larger than others and somewhat canine-like. Upper profile of head nearly straight, not roundly convex. Diameter of orbit usually slightly shorter than interorbital space which is nearly flattened. Preopercular margin crenulate, but without bony serrae. Second anal spine short and weak, always shorter than diameter of orbit. Soft dorsal rays 27 to 32, but usually more than 29 rays; first dorsal spines 10 or rarely 9; anal II, 7. Pored scales on lateral line 49 to 55, mostly 50 to 53; two rows of small scales arranged irregularly at the base of soft dorsal; anal devoid of scales. Gill-rakers on first arch 15 to 18, but almost all of them provided with 16 or 17, the longest one 8.00 to 14.00 in head, shorter in larger specimens than in smaller ones proportionally. Body gray, somewhat paler below; a rather large black blotch on operculum and a smaller one on axil of pectoral; fins light gray, except ventral which is white. Mouth and branchial cavities dark; peritoneum jet black.

The largest specimen that I observed is 446mm in body length, but Mr. K. Ebina informed me that he saw many specimens of about 2 meters long at Hirosima fishmarket.

As plotted in Fig. 19–22 and tabulated in Table 6, the Japanese and Chinese specimens may be included in one category, though the soft dorsal rays and pored sacles on lateral line are somewhat fewer in number in Japanese specimens as in the case of *Nibea argentata* (Houttuyn).

My specimens differ from one of *Sciaena nibe* described by Jordan & Thompson[42] in having somewhat shorter snout and narrower interorbital space, but quite agree with it in other important characters.

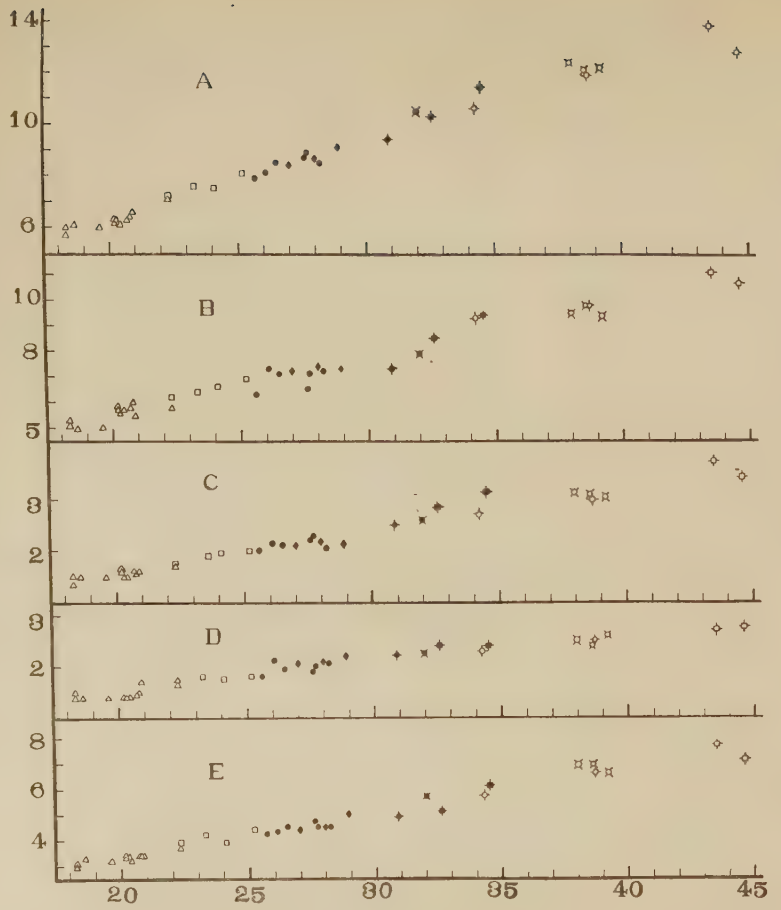


Fig. 19. Showing dimention (in cm) of body parts in relation to body length of *N. nibe*. A, length of head; B, depth of body; C, length of snout; D, diameter of orbit; E, length of postorbital part of head. △, one year old; □, two years; ○, three yeas; ◇, four years; ⟡, five years; ⟡, six years; ⟡, seven years (White symbols indicate the Japanese specimens and solid ones show the China specimens).

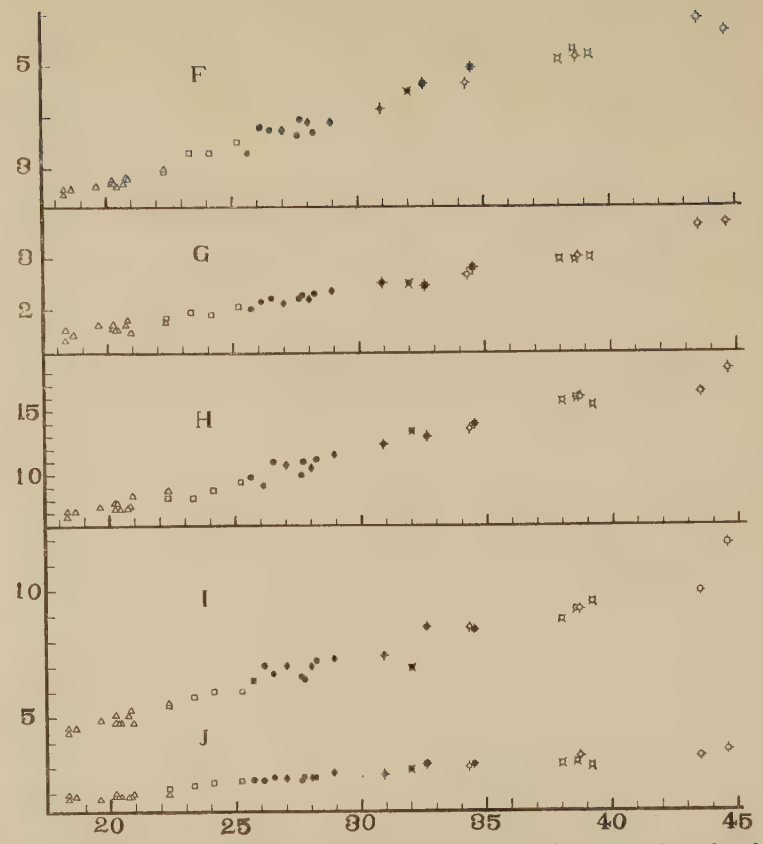


Fig. 20. Same as in Fig. 19 with same yearly symbols. F, length of maxillary; G, width of interorbital space; H, distance from origin of ventral to anal; I, length of caudal peduncle, J, depth of caudal peduncle.

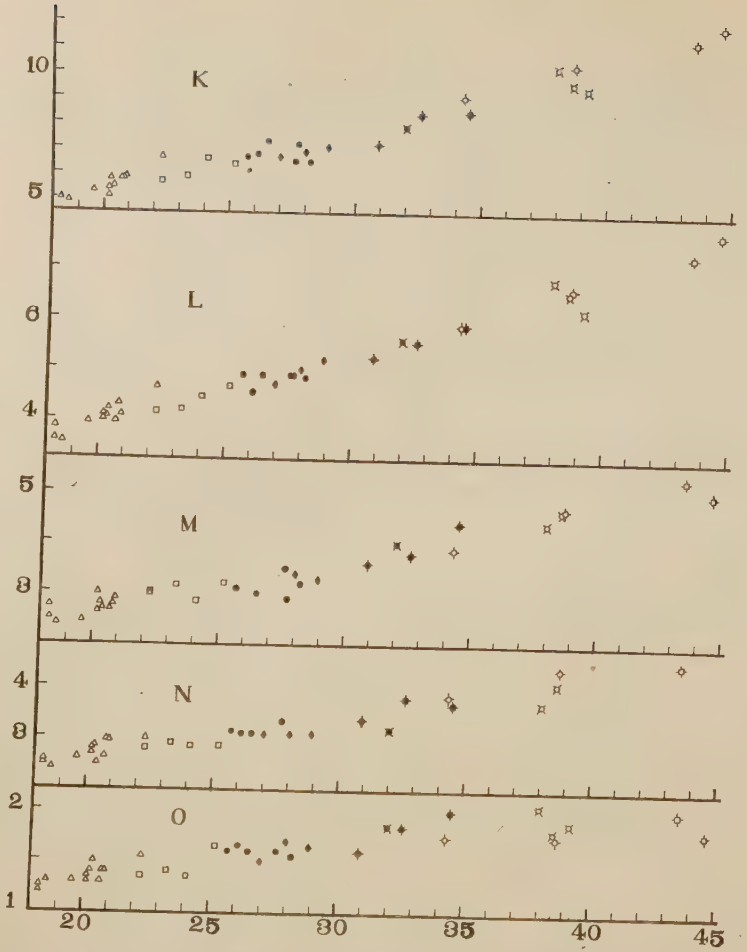


Fig. 21. Same as in Fig. 19 with same yearly symbols. K, length of pectoral; L, length of ventral; M, length of the longest dorsal spine; N, length of the longest dorsal ray; O, length of second anal spine.

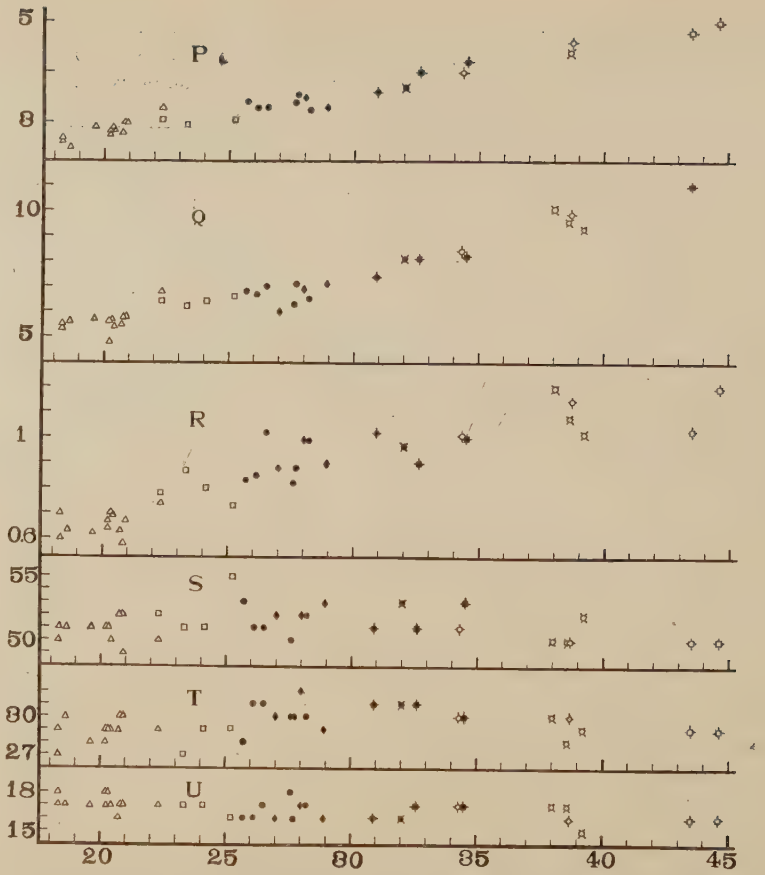


Fig. 22. Same as in Fig. 19 with same yearly symbols. P, length of the longest anal ray; Q, length of caudal fin; R, length of the longest gill-raker on first arch; S, number of scales on lateral line; T, number of soft dorsal rays; U, number of gill-rakers on first arch.

Fowler[20] united this species with *Sciaena japonica* of Temminck & Schlegel and other writers put it under the name of *Johnius argentatus* (Houttuyn), but the present species quite differs from the latter in having the following important characters: 1) Mouth and branchial cavities dark, peritoneum jet black; body gray, axil of pectoral with a rather large black blotch; 2) jaws subequal or lower jaw slightly longer than upper; 3) upper profile of head usually straight, not roundly convex; 4) second anal spine always shorter than diameter of orbit; 5) outer teeth of upper jaw and inner ones of lower jaw much larger and somewhat canine-like; 6) two rows of small scales arranged irregularly along the base of soft dorsal; 7) body length reaches at least more than 450mm (in *N. argentata* rarely attains to 400mm in body length).

The present species undoubtedly differs from *N. japonica*, at least, in having jet black peritoneum and the caudal spatulated, never double concave as is the case with the latter species.

13 specimens from China Sea, 26 from Miya, Aiti-Ken and 1 from Hirosima fish-market have come under my examination.

Habitat: Known from Miya (Aiti-Ken) to China Sea, especially abundant in the latter, but not recorded from the Japan Sea.

## Genus *Johnius* Bloch.

*Johnius* Bloch, 1793, Naturg. Auslaend. Fische, pt. 7, p. 132.
Type: *Johnius carutta* Bloch.

### *Johnius belengerii* (Cuvier & Valenciennes)

New Japanese name: *Kon be*

*Corvina belengerii* Cuvier & Valenciennes, 1830, p. 120 (Malabar).
*Corvina belangerii* Günther, 1860, p. 302 (Pinang).
*Corvina belengeri* Day, 1870, p. 648 (Andamans).
*Johnius belengeri* Bleeker, 1873, p. 118 (China).——Bleeker, 1877, p. 387, fig. 1.——Herre, 1934, p. 57 (Manila).
*Sc'œna belengeri* Day, 1876, p. 191, pl. 44, fig. 5 (India, Bombay).——Barnard, 1927, p. 572 (Natal).
*Sciaena belangeri* Günther, 1889, p. 120 (India).——Hardenberg, 1931, p. 131 (Rokan Mouth).
*Johnius belangeri* Fowler, 1928, p. 235 (from Day).
*Johnius belengerii* Fowler, 1933, p. 382 (Bombay, India).——Hardenberg, 1934, p. 309 (Rokan Mouth).——Lin, 1934, p. 681 (Foochow, Fukien).——Lin, 1935, p. 13.——Weber & Beaufort, 1936, p. 533.

Head 3.69 in body length: depth at origin of ventral 3.89; same at middle of belly 3.70; distance between origin of ventral and that of anal 2.68; length of caudal peduncle 2.68.

Orbit 4.00 in head; snout 3.94; maxillary 2.58; interorbital space 3.37; width of preorbital 6.13; postorbital part of head 2.01; depth of caudal peduncle 3.14; pectoral 1.38; longest dorsal spine (third one) 1.58; longest dorsal ray 1.93; second anal spine 2.46; longest anal ray 1.59; ventral 1.26; caudal 0.92.

D. X–I, 26; A. II, 8; P. 18; branchiostegal rays 7; scales about 47 in lateral line; gill-rakers on first arch 6+12=18, very short, the longest one 3.83 in horizontal diameter of orbit.

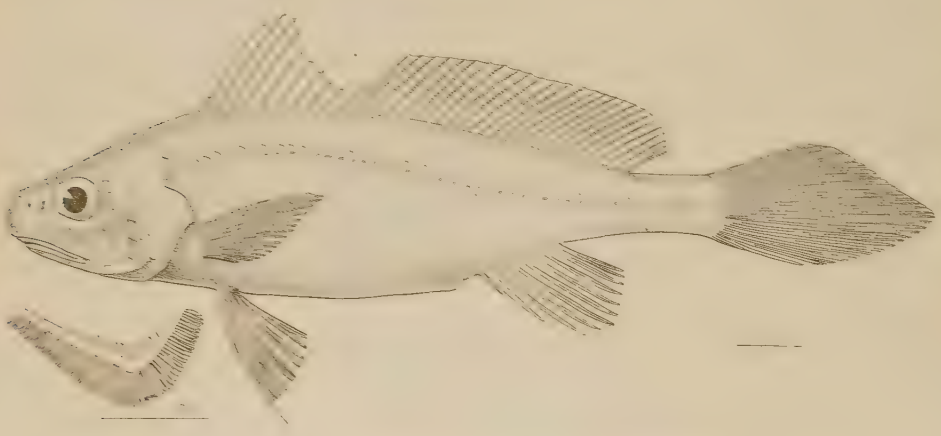

Fig. 23. *Johnius belengerii* (CUVIER & VALENCIENNES).

Body somewhat elongate, compressed, its width twice its depth. Dorsal profile gradually and evenly arched; ventral outline somewhat less arched. Snout blunt, its tip nearly vertical and extends beyond tip of upper jaw. Mouth inferior, lower jaw entirely included when mouth is closed; cleft of mouth nearly horizontal, maxillary extends below posterior border of pupil. Teeth villiform, outer upper row slightly enlarged, lower teeth uniformly small; vomer and palate edentate. Chin with five pores at symphysis: no barbels. Preopercular margin weakly serrated. Opercle ending in two points, but not projected beyond gill-membrane. Eye rather large, as long as length of snout. Interorbital space slightly elevated.

Dorsal fin naked, begining behind base of pectoral, with a deep

notch between spinous and soft portions; dorsal spines weak, third one the longest, quite as long as the distance between center of eye and tip of opercular flap. Anal commences under middle of soft dorsal base; anal spines rather strong, but second one shorter than postorbital part of head. Pectoral rather long, subequal to ventral. Median caudal rays produced.

Body covered with fine etenoid scales except lips, jaws and fins.

Lateral line distinct, concurrent with back to above origin of anal, then it follows body axis.

Color in formalin uniformly light gray, a large black blotch on operculum; mouth colorless; branchiostegal cavity and peritoneum blackish.

The foregoing description and figures are drawn from a ripe female specimen, Imp. Fish. Inst. Fish Spec. No. 3513, measuring 131 mm (body length 101.8 mm.), obtained by Mr. Keitarô Uchida at Gunzan, Tyôsen.

The dimensions of the other one ripe male specimen, procured also by Mr. Keitarô Uchida at Gunzan, run as follows:

Total length 113.5 mm; body length 85.8 mm; head 3.58 in body length; depth at origin of ventral 4.06; distance between origin of ventral and that of anal 3.06; length of caudal peduncle 4.10. Orbit 3.70 in head; snout 3.58; maxillary 2.58; interorbital space 3.33; width of preorbital 6.32; postorbital part of head 1.95; depth of caudal peduncle 3.43; longest dorsal spine (third one) 1.92; longest dorsal ray 1.86; second anal spine 2.33; longest anal ray 1.51; ventral 2.20; caudal 0.85. D. X–I, 27; A. II, 8; P. 20; branchiostegal rays 7; scales about 45 on lateral line; gill-rakers on first arch 6+12=18, the longest one 3.82 in diameter of orbit.

My specimens have somewhat fewer soft dorsal rays than the one identified as Cuvier & Valenciennes's *Corvina belengerii* by many writers, but quite agree with them in other important characters.

The present species closely resembles *Corvina hypostoma* of Bleeker, particularly in having no enlarged teeth on lower jaw and mouth opening inferiorly, but separable from it, at least, in having fewer dorsal rays (in *C. hypostoma* 32 or 33) and soft vertical rays naked (in *C. hypostoma*, basal half finely scaled).

It should be mentioned that the present species is ripe at very small size as noted above.

Distribution: Widely spread from Tyôsen to South Africa. This species is new to fauna of Tyôsen.

## Genus *Pseudosciaena* BLEEKER

*Pseudosciæna* BLEEKER, 1863, p. 142. Type: *Pseudosciaena amblyceps* BLEEKER.
*Othonias* JORDAN & THOMPSON, 1911, p. 244. Type: *Sciaena manchurica* JORDAN & THOMPSON.

### Key to species of *Pseudosciaena*

A Vertebrae 25 or 26 (including hypural); soft anal rays usually 8, rarely 7 or 9; second anal spine 4.00 to 6.00 in head, but mostly 4.00 to 5.50 and usually longer than diameter of orbit; the fish reaches more than 500mm in body length.... *P. crocea.*

AA Vertebrae 28 to 30 (including hypural), but almost all of them provided with 29 vertebrae; soft anal rays always 9 or 10; second anal spine shorter, 5.00 to 8.00 in head, but usually 5.50 to 8.00 in head and always much shorter than diameter of orbit; body length usually shorter than 300mm....*P. manchurica.*

### *Pseudosciaena crocea* (RICHARDSON)

Japanese name: *Hûsei*

*Sciaena crocea* RICHARDSON, 1846, p. 224 (Canton).
*Pseudosciaena amblyceps* BLEEKER, 1863, p. 8 (Amoy).——LIN, 1935, p. 9 (Shangtung to Kwangtung).
?*Pseudosciaena polyactis* BLEEKER, 1879, p. 5, pl. 1, fig. 1 (Shanghai).
*Pseudosciaena undovittata* JORDAN & SEALE, 1905, p. 11, pl. 6 (Hongkong).
*Sciaena distincta* TANAKA, 1916a, p. 262 (Nagasaki market).
*Othonias undovittatus* MOEI & UCHIDA, 1934, p. 14 (Tinnanpo).

Body slender and compressed. Head cavernous; snout short and blunt. Interorbital space roundly convex, much wider than length of snout or diameter of orbit. Jaws equal or lower jaw slightly longer; mouth very large and oblique, maxillary extends somewhat beyond posterior end of orbit. Second anal spine short and weak, but slightly longer or as long as diameter of orbit. Soft dorsal rays 31 to 34, rarely 30 or 35; soft anal rays 7 to 9, but mostly 8. Soft dorsal and anal covered with small feeble scales from base to margin. Scales on lateral line 51 to 56, but mostly 52 to 55. Gill-rakers on first arch 25 to 31, but almost all of them 26 to 29, long and slender, the longest one on first arch 7.00 to 11.00 in head. Vertebrae mostly 26, rarely 25 including hypural. The present species grows to a large size, more than 500mm

in body length.

My specimens quite agree with that of JORDAN & SEALE's[37] *Pseudosciaena undovittata*, but not with LIN's[48] *P. undovittata*. I regard *P. undovittata* of JORDAN & SEALE as a synonym of RICHARDSON's *Sciaena crocea* on the basis of the following description of the latter: "D 9|—1|33; A 1|8. Pectorals, under part of the body, sides of head, and ventral spine saffron-yellow, the anal showing a reddish orange hue. The fish attains a considerable size."

In *P. manchurica*, the soft anal rays are always 9 or 10 and body length mostly shorter than 300mm. BLEEKER's *Pseudosciaena amblyceps* should be also identical with Richardson's *Sciaena crocea*, at least, in having 8 or 9 soft anal rays.

*Sciaena distincta* TANAKA[67] agrees with RICHARDSON's *Sciaena crocea* and JORDAN & SEALE's *P. undovittata* in having the following characters: 1) Soft dorsal covered with scales; 2) Second anal spine $4^1/_4$ in head and slightly longer than diameter of eye; 3) anal rays II, 7.

Examined 39 specimens from China Sea and 5 from Huzan.

Distribution: Southern part of Tyôsen to China Seas.

### *Pseudosciaena manchurica* JORDAN & THOMPSON

Japanese name: *Kinguti*.

*Sciaena manchurica* JORDAN & THOMSON, 1911, p. 255 (Port Arthur, Manchuria).
——JORDAN & METZ, 1913, p. 38, fig. 28 (copied).
*Sciaena ogiwara* NICHOLS, 1913, p. 180 (Simonoseki).
*Sciaena aurea* TANAKA, 1916 a, p. 26 (Nagasaki market).
*Othonias undovittatus* JORDAN & HUBBS, 1925, p. 244 (Ôsaka market).
*Pseudosciaena undovittata* LIN (not of JORDAN & SEALE), 1935, p. 9 (Shangtung coast).
*Pseudosciaena amblyceps* FOWLER (not of BLEEKER), 1933, p. 369 (China, Japan).

The present species is much like *P. crocea* in general appearance. The second anal spine short, much shorter than diameter of orbit. Vertebrae mostly 29 (including hypural), rarely 30 or 28. Soft dorsal rays 31 to 37; soft anal rays 9 or 10. Scales on lateral line 53 to 59, rarely 60. The present species does not usually reach more than 300 mm in body length. In life, deeply tinged with orange yellow, especially conspicuous on belly.

My specimens are similar to those of original descriptions of *S. manchurica*,[42] *S. ogiwara*[53] and *S. aurea*[67] in having 9 or 10 anal

rays and short anal spines, usually much shorter than the diameter of orbit, though the number of vertebrae is not stated in their original descriptions.

LIN[48] identified those individuals which are provided with 28 vertebrae and the second anal spine much shorter than diameter of eye as *P. undovittata*, and defined those with 25 vertebrae as *P. amblyceps*. But *P. undovittata* of JORDAN and SEALE seems to be identical with *P. crocea* RICHARDSON by having 7 or 8 soft anal rays and the second anal spine longer than the diameter of the eye; and *P. amblyceps* of BLEEKER appears to be identical with *P. crocea* (RICHARDSON) by having 8 or 9 soft anal rays.

LIN[48] thought that the relative depth of caudal peduncle to its length as an important character for separating the above-mentioned two species, but it is obvious that it does not hold true (Fig. 26 H.I).

In Fig. 24–28 are plotted 62 specimens of *P. manchurica* and 47 specimens of *P. crocea* with respects to a number of characters, but they can be easily distinguished one from the other by the following four items:

1) *Number of vertebrae*: It is fewer in *P. crocea*, 45 specimens being provided with 26 vertebrae including hypural and only two with 25 vertebrae. In *P. machurica*, 58 specimens are provided with 29 vertebrae, only one with 28 vertebrae and three with 30 vertebrae.

2) *Length of second anal spine*: The second anal spine is longer in *P. corcea* than in *P. manchurica*, varying 4.00 to 6.00 in head, but mostly 4.00 to 5.50 in head and usually longer than diameter of orbit. In *P. manchurica*, the second anal spine 5.00 to 8.00 in head, but almost all of them 5.50 to 8.00 in head, and always much shorter than diameter of orbit.

3) *Number of soft anal rays*: *P. crocea* usually possesses 8 rays and rarely 7 or 9 rays, but the other is always provided with 9 or 10 rays.

4) *Body length*: *P. croeea* usually reaches more than 500mm in body length, but mostly less than 300mm in body length in *P. manchurica*.

I obtained 34 specimens from Huzan and 28 from China Sea.

Distribution: Southern part of Tyôsen and Port Arthur to China Sea.

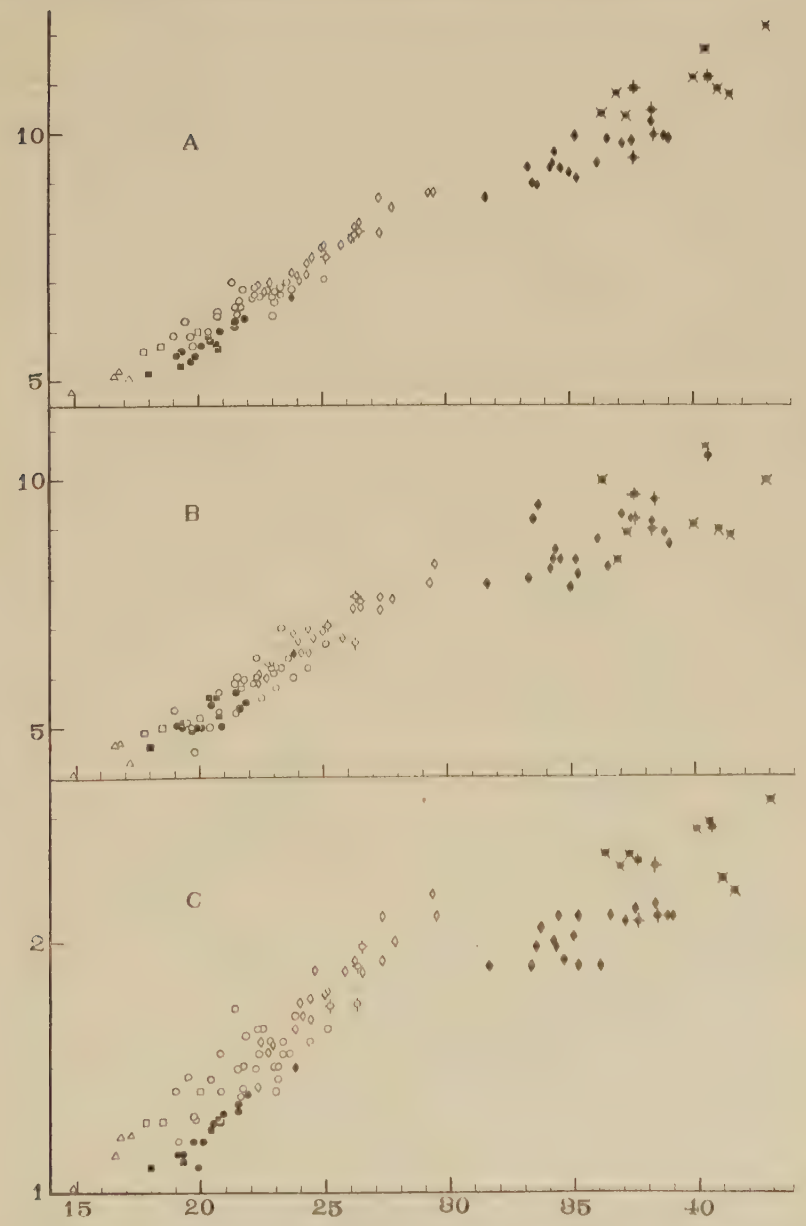


Fig. 24. Showing dimension (in cm) of body parts in relation to body length of *Pseudosciaena crocea* and *P. manchurica*. A, length of head; B, depth of body; C, length of snout. *P. manch.* △, one year old; □, two years; ○, three years; ◇, four years; ⊹, five years. *P. croc.* ▲, one year old; ■, two years; ●, three years; ◆, four years; ✦ five years; ✱, six years; ✚, seven years.

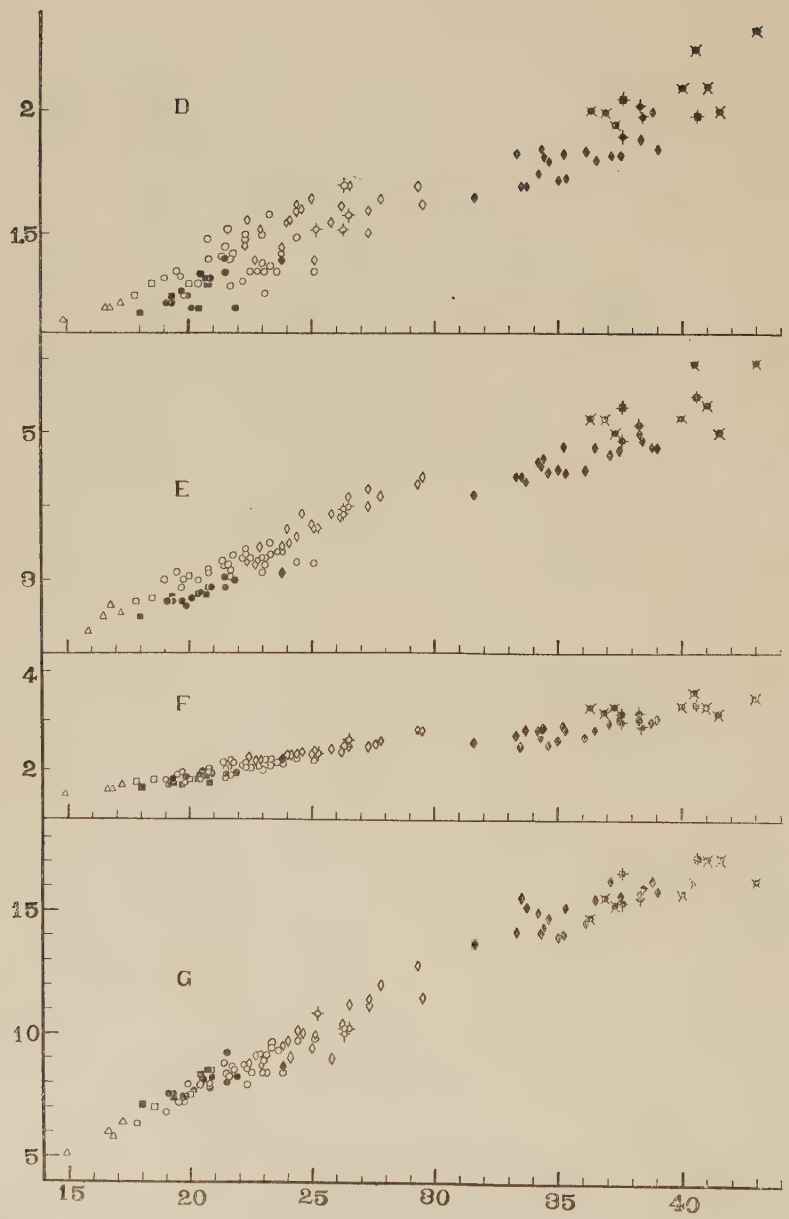


Fig. 25. Same as in Fig. 24 with the same yearly symbols. D, diameter of orbit; E, length of maxillary; F, width of interorbital space; G, distance from origin of ventral to anal.

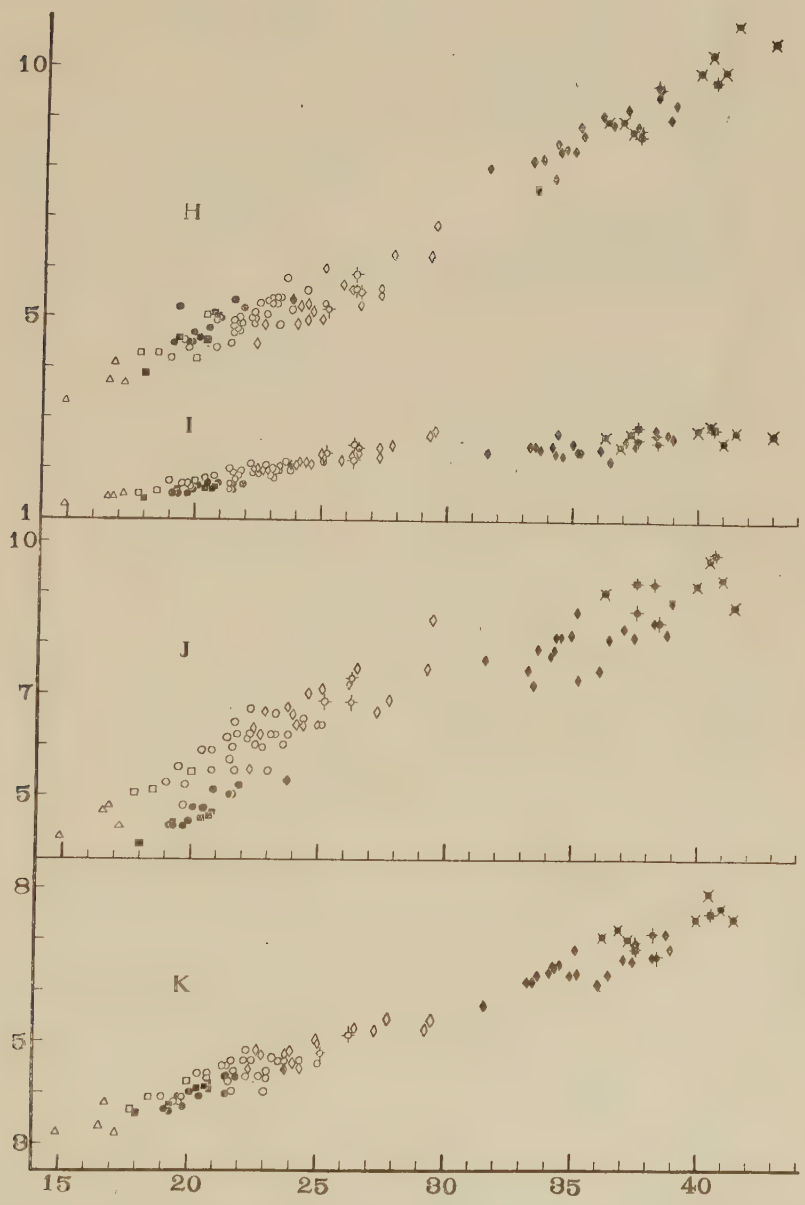


Fig. 26. Same as in Fig. 24 with same yearly symbols. H, length of caudal peduncle; I, depth of caudal peduncle; J, length of pectoral; K, length of ventral.

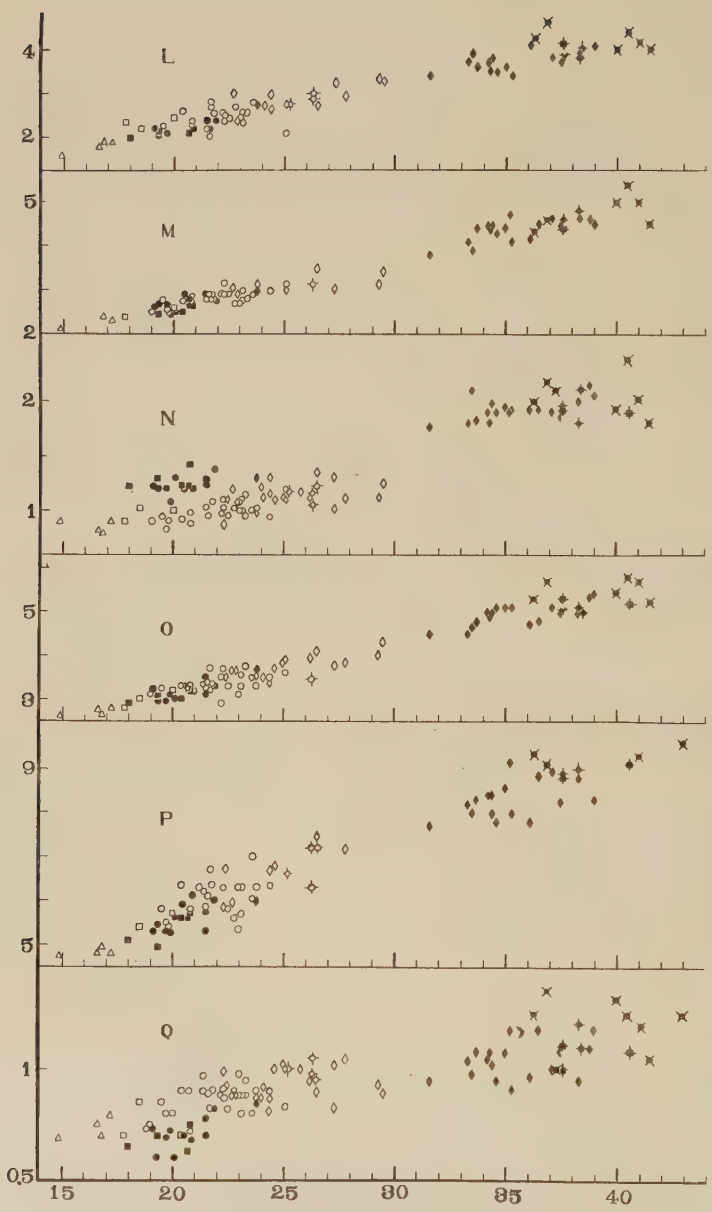


Fig. 27. Same as in Fig. 24 with same yearly symbols. L, length of the longest dorsal spine; M, length of the longest dorsal ray; N length of second anal spine; O, length of the longest anal ray; P, length of caudal fin; Q, length of the longest gill-raker on first arch.

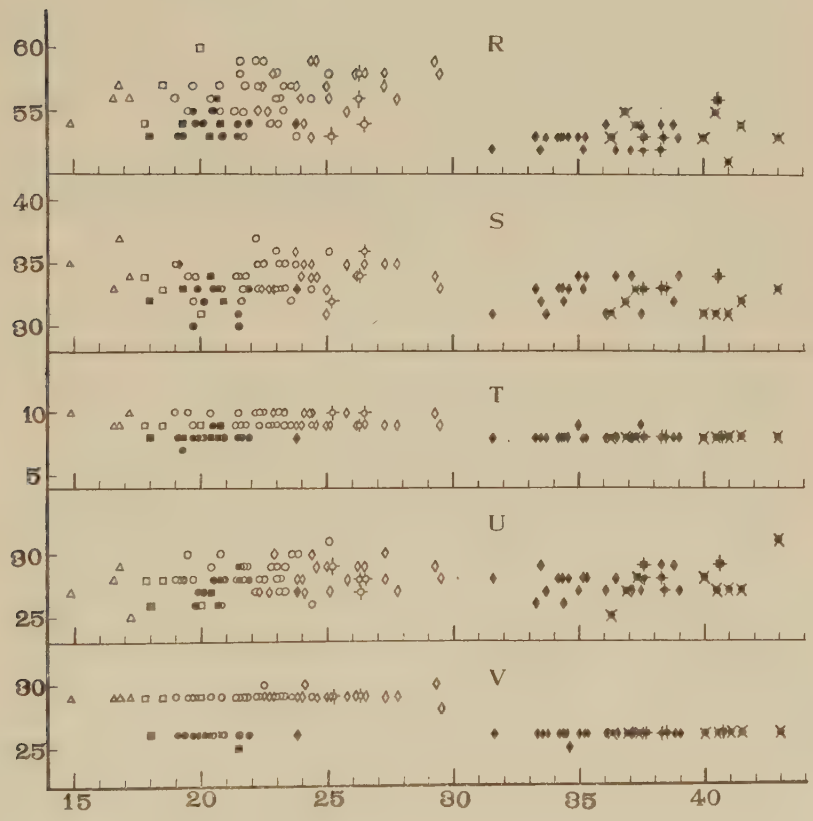


Fig. 28. Same as in Fig. 24 with same yearly symbols. R, number of pored scales on lateral line; S. number of soft dorsal rays; T, number of soft anal rays; U, number of gill-rakers on first arch; V, number of vertebrae (including hypural).

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Table II. Frequencies of body proportions of *Nibea mitsukurii* (JORDAN & SNYDER)

Locality: A, Miya; B, Tôkyô Bay; C, Siogama.
Age: I, one year; II, two years; III, three years; IV, four years, and V, five years old.

| Loc. | Head in body length | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.20-3.30 | | | | | 3.30-3.40 | | | | | 3.40-3.50 | | | | | 3.50-3.60 | | | | | 3.60-3.70 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | 1 | 1 | 6 | 6 | 3 | 3 | 13 | 12 | 7 | 1 | 6 | 12 | 5 | 2 | 2 | 4 | 3 | | 1 | | 2 | | — | - |
| B | 1 | — | — | — | — | 1 | — | — | — | — | — | 3 | 1 | | | - | - | - | — | — | - | - | — | — | — |
| C | — | — | — | — | — | - | — | — | — | — | — | 1 | 4 | | | | 1 | - | — | | | — | | - | - |

| Loc. | Depth in body length | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.30-3.40 | | | | | 3.40-3.50 | | | | | 3.50-3.60 | | | | | 3.60-3.70 | | | | | 3.70-3.80 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | 1 | — | 1 | — | 2 | 2 | 1 | — | 1 | 1 | 3 | 7 | 5 | 3 | 2 | 2 | 7 | 4 | 4 | 1 | 2 | 9 | 5 | 4 |
| B | — | — | — | — | — | — | — | 1 | — | — | — | 1 | — | — | — | — | 1 | — | — | — | - | - | - | - | - |
| C | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | - | - | 3 | - | - |

| Loc. | Depth in body length | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.80-3.90 | | | | | 3.90-4.00 | | | | | 4.00-4.10 | | | | | | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | | | | | |
| A | - | 4 | 3 | 6 | 2 | — | 2 | 1 | 2 | 1 | - | - | 1 | - | 1 | | | | | |
| B | - | 1 | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | | | | | |
| C | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | | | | | |

| Loc. | Snout in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4.10-4.20 | | | | | 4.20-4.30 | | | | | 4.30-4.40 | | | | | 4.40-4.50 | | | | | 4.50-4.60 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 3 | 1 | 1 | — | 1 | 3 | — | — | - | 4 | 2 | 4 | 3 | - | 1 | 6 | 12 | 4 | 1 | 5 | 6 | 3 | 5 |
| B | 1 | 2 | — | — | — | — | — | 1 | — | — | — | 1 | — | — | — | — | — | — | — | — | - | - | | | |
| C | - | 1 | 2 | — | — | — | — | 1 | — | — | - | — | — | — | — | — | 1 | — | — | — | - | 1 | - | - | - |

| Loc. | Snout in head | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 4.60-4.70 | | | | | 4.70-4.80 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V |
| A | - | 2 | 5 | 1 | 1 | 2 | 3 | 3 | 2 | 1 |
| B | 1 | - | - | - | - | - | - | - | - | - |
| C | - | - | - | - | - | - | - | - | - | - |

| Loc. | Orbit in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4.20-4.50 | | | | | 4.50-4.80 | | | | | 4.80-5.10 | | | | | 5.10-5.40 | | | | | 5.40-5.70 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | 1 | 2 | — | — | — | 5 | 3 | 2 | 3 | — | — | 9 | 15 | 4 | — | — | 2 | 7 | 7 | 5 | — | — | 5 | 9 | 11 |
| B | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | 1 | 3 | — | — | — | — | — | — | — | — |
| C | — | — | — | — | — | — | — | — | — | — | — | 2 | 1 | | | — | — | 3 | — | — | — | — | — | — | — |

| Loc. | Maxillary in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.30-2.40 | | | | | 2.40-2.50 | | | | | 2.50-2.60 | | | | | 2.60-2.70 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | 2 | 1 | 1 | — | 4 | 10 | 17 | 13 | 8 | 1 | 3 | 11 | 8 | 5 | 1 | 1 | | 1 | 3 |
| B | — | 2 | 1 | | | 2 | 1 | — | — | — | — | — | — | | — | | — | | — | — |
| C | — | 2 | — | — | - | — | — | 3 | | | - | — | 1 | | — | — | | | — | — |

Interorbital space in head

| Loc. | 3.10-3.20 | | | | | 3.20-3.30 | | | | | 3.30-3.40 | | | | | 3.40-3.50 | | | | | 3.50-3.60 | | | | | 3.60-3.70 | | | | | 3.70-3.80 | | | | | 3.80-3.90 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | - | - | - | - | - | - | 4 | 2 | - | - | - | 2 | 4 | - | 1 | 1 | 5 | 9 | 6 | 4 | 2 | 5 | 10 | 7 | 5 | 1 | - | 3 | 8 | 4 | 2 | - | 1 | 2 | - | - | - | - | - | 2 |
| B | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| C | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| Loc. | Postorbital part of head in head | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.60-1.70 | | | | | 1.70-1.80 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V |
| A | 3 | 9 | 20 | 16 | 16 | 3 | 7 | 9 | 7 | — |
| B | — | — | — | — | — | 2 | 3 | 1 | — | — |
| C | — | 1 | 4 | — | — | — | 1 | — | — | — |

Distance from origin of ventral to anal in body length

| Loc. | 2.30-2.40 | | | | | 2.40-2.50 | | | | | 2.50-2.60 | | | | | 2.60-2.70 | | | | | 2.70-2.80 | | | | | 2.80-2.90 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 3 | 1 | 5 | 1 | 6 | 15 | 11 | 8 | 3 | 6 | 9 | 7 | 3 | 2 | 4 | 2 | 4 | — | — | — | — | — | — | — | — | — | — |
| B | — | — | — | — | — | — | — | — | — | — | — | 2 | 1 | — | — | — | — | — | — | — | — | 1 | — | — | — | 2 | — | — | — | — |
| C | — | — | — | — | — | — | — | 1 | — | — | — | 1 | 2 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 1 | — | — | — |

Length of caudal peduncle in head

| Loc. | 1.10-1.20 | | | | | 1.20-1.30 | | | | | 1.30-1.40 | | | | | 1.40-1.50 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | 2 | — | — | — | 5 | 8 | 15 | 5 | 7 | — | 4 | 11 | 15 | 6 | 1 | 2 | 3 | 3 | 3 |
| B | — | 2 | — | — | — | 2 | — | — | — | — | — | 1 | 1 | — | — | — | — | — | — | — |
| C | — | — | 1 | — | — | — | 2 | 2 | — | — | — | — | 1 | — | — | — | — | — | — | — |

Depth of caudal peduncle in head

| Loc | 2.80-2.90 | | | | | 2.90-3.00 | | | | | 3.00-3.10 | | | | | 3.10-3.20 | | | | | 3.20-3.30 | | | | | 3.30-3.40 | | | | | 3.40-3.50 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | 1 | 1 | — | — | — | 2 | 1 | 3 | — | 1 | 2 | 6 | 9 | 2 | — | 1 | 5 | 3 | 7 | 5 | — | 2 | 11 | 7 | 2 | — | 1 | 3 | 4 | 5 | — | — | — | 2 | 4 |
| B | — | — | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | 1 | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — |
| C | — | 1 | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — |

| Loc | Pectoral in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.20–1.30 | | | | | 1.30–1.40 | | | | | 1.40–1.50 | | | | | 1.50–1.60 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | 2 | 5 | 2 | 2 | 4 | 12 | 16 | 11 | 8 | 2 | 2 | 8 | 8 | 6 | — | — | — | 2 | — |
| B | — | — | — | — | — | 2 | 3 | 1 | — | — | — | — | — | — | — | — | — | — | — | — |
| C | — | — | 1 | — | — | — | 1 | 3 | — | — | — | 1 | — | — | — | — | — | — | — | — |

| Loc. | Ventral in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.20–1.30 | | | | | 1.30–1.40 | | | | | 1.40–1.50 | | | | | 1.50–1.60 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | 1 | 2 | — | — | — | 2 | 10 | 10 | 5 | 4 | 3 | 4 | 18 | 15 | 8 | — | — | 1 | 3 | 4 |
| B | 1 | 1 | — | — | — | 1 | 1 | 1 | — | — | — | 1 | — | — | — | — | — | — | — | — |
| C | — | 1 | 1 | — | — | — | 1 | 1 | — | — | — | — | 2 | — | — | — | — | — | — | — |

| Loc. | Longest dorsal spine in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.60–1.70 | | | | | 1.70–1.80 | | | | | 1.80–1.90 | | | | | 1.90–2.00 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | — | 1 | — | 2 | 1 | — | — | 1 | 5 | 6 | 2 | — | 1 | 4 | 6 | 1 | 1 |
| B | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 1 | 1 | - | - |
| C | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | 1 | - | - | - | - | 1 | - | - |

| Loc. | Longest dorsal spine in head | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2.00–2.10 | | | | | 2.10–2.20 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V |
| A | 1 | 2 | 5 | 9 | 5 | 2 | 1 | 3 | 3 | 3 |
| B | - | - | - | - | - | 1 | - | - | - | - |
| C | - | - | - | - | - | - | - | - | - | - |

| Loc | Longest dorsal ray in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.00–2.10 | | | | | 2.10–2.20 | | | | | 2.20–2.30 | | | | | 2.30–2.40 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | - | 1 | - | - | - | 2 | - | - | - | - | 3 | 3 | 4 | - | - | 1 | 11 | 7 | 4 | 1 |
| B | - | - | - | - | - | - | 1 | - | - | - | 2 | 1 | 1 | - | - | - | 1 | - | - | - |
| C | - | 2 | - | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 2 | - | - |

| Loc. | Second anal spine in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.20–2.30 | | | | | 2.30–2.40 | | | | | 2.40–2.50 | | | | | 2.50–2.60 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | 2 | 1 | - | - | - | 1 | 3 | - | - | - | 2 | 5 | 4 | 3 | 1 | 1 | 6 | 8 | 3 | 1 |
| B | 1 | - | - | - | - | 1 | 1 | - | - | - | - | 1 | - | - | - | - | 1 | 1 | - | - |
| C | - | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |

| Loc. | Second anal spine in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.60–2.70 | | | | | 2.70–2.80 | | | | | 2.80–2.90 | | | | | 2.90–3.00 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | 1 | 9 | 3 | 6 | - | 5 | 4 | 1 | - | - | 3 | 4 | 2 | - | - | 1 | 2 | - | - | - |
| B | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| C | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |

| Loc. | Second anal spine in head | | | | | |
|---|---|---|---|---|---|---|
| | 3.00–3.10 | | | | | |
| | I | II | III | IV | V | |
| A | - | - | 4 | 2 | - | |
| B | - | - | - | - | - | |
| C | - | - | - | - | - | |

| Loc. | Longest anal ray in head | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.60–1.70 | | | | | 1.70–1.80 | | | | | 1.80–1.90 | | | | | 1.90–2.00 | | | | | 2.00–2.10 | | | | | 2.10–2.20 | | | | | 2.20–2.30 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | 1 | — | — | — | 1 | 1 | — | — | — | 3 | 5 | 5 | — | — | 2 | 5 | 10 | 8 | 1 | — | 1 | 11 | 9 | 11 | — | 1 | 2 | 3 | — | — | — | — | 2 | 4 |
| B | — | — | — | — | — | 1 | — | — | — | — | 1 | 2 | 1 | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| C | — | — | — | — | — | — | 2 | — | — | — | — | — | 1 | — | — | — | — | 2 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — |

| Loc. | Caudal in head | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.00–1.10 | | | | | 1.10–1.20 | | | | | 1.20–1.30 | | | | | 1.30–1.40 | | | | | 1.40–1.50 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | 1 | 1 | — | — | — | 4 | 8 | 11 | 3 | 3 | 1 | 7 | 14 | 19 | 11 | — | — | 3 | 1 | 1 | — | — | 1 | — | — |
| B | — | — | — | — | — | 2 | 1 | 1 | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — |
| C | — | — | — | — | — | — | 2 | 1 | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — |

| Loc. | Longest gill-raker on first arch in head | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7.00–8.00 | | | | | 8.00–9.00 | | | | | 9.00–10.00 | | | | | 10.00–11.00 | | | | | 11.00–12.00 | | | | | 12.00–13.00 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | — | — | 2 | 4 | 7 | — | — | 3 | 11 | 13 | 8 | 2 | 1 | 1 | 8 | 9 | 5 | — | — | 1 | 4 | 8 | — | — | — | 2 | 1 |
| B | 1 | — | — | — | — | 1 | 1 | 1 | — | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — |
| C | — | 1 | — | — | — | — | — | 4 | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

| Loc. | Number of pored scales on lateral line | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
| A | 4 | 3 | 14 | 21 | 17 | 24 | 7 | — |
| B | — | — | — | 1 | 1 | 1 | 1 | — |
| C | — | — | — | 1 | 1 | 2 | 1 | 1 |

| Loc. | Number of soft dorsal rays | | | | | | |
|---|---|---|---|---|---|---|---|
| | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| A | 1 | 3 | 18 | 40 | 21 | 4 | 3 |
| B | — | — | 2 | 1 | 2 | 1 | — |
| C | — | 1 | 3 | 1 | 1 | — | — |

| Loc. | Number of pectoral rays | | | | |
|---|---|---|---|---|---|
| | 15 | 16 | 17 | 18 | 19 |
| A | 1 | 25 | 58 | 5 | 1 |
| B | — | 2 | 4 | — | — |
| C | — | 4 | 2 | — | — |

| Loc | Number of gill-rakers on first arch | | | | | |
|---|---|---|---|---|---|---|
| | 22 | 23 | 24 | 25 | 26 | 27 |
| A | 6 | 25 | 23 | 26 | 9 | 1 |
| B | — | 2 | 4 | — | — | — |
| C | — | 2 | 2 | 1 | 1 | — |

Table III. Frequencies of body proportions of *Nibea albiflora* (Richardson)

Locality : Huzan.

Age : I, one year ; II, two years ; III, three years ; IV, four years, and V, five years old.

Head in body length

| 3.20-3.30 | | | | | 3.30-3.40 | | | | | 3.40-3.50 | | | | | 3.50-3.60 | | | | | 3.60-3.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | 1 | — | — | — | 11 | 8 | — | — | — | 20 | 14 | 2 | 1 | 1 | 9 | 17 | — | 3 | 5 | 1 | 1 | — | — | 3 |

Depth in body length

| 3.50-3.60 | | | | | 3.60-3.70 | | | | | 3.70-3.80 | | | | | 3.80-3.90 | | | | | 3.90-4.00 | | | | | 4.00-4.10 | | | | | 41.0-4.20 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | IV | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 1 | 1 | — | 1 | — | 4 | 4 | — | 1 | 1 | 8 | 14 | — | 1 | 1 | 14 | 13 | 2 | 1 | 4 | 7 | 6 | — | — | 2 | 6 | 3 | — | — | 1 | 1 | — | — | — | — |

Snout in head

| 3.50-3.60 | | | | | 3.60-3.70 | | | | | 3.70 3.80 | | | | | 3.80 3.90 | | | | | 3.90-4.00 | | | | | 4.00-4.10 | | | | | 4.10-4.20 | | | | | 4.20-4.30 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 1 | 1 | — | — | — | 5 | 4 | 1 | — | — | 4 | 6 | 1 | 2 | 1 | 8 | 5 | — | — | 3 | 11 | 14 | — | 2 | 3 | 8 | 8 | — | — | 2 | 3 | 2 | — | — | — | 1 | 1 | — | — | — |

Orbit in head

| 4.40-4.70 | | | | | 4.70-5.00 | | | | | 5.00-5.30 | | | | | 5.30-5.60 | | | | | 5.60-5.90 | | | | | 5.90-6.20 | | | | | 6.20-6.40 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 10 | 2 | — | — | — | 21 | 6 | — | — | — | 10 | 16 | 1 | — | — | — | 10 | 1 | 2 | — | — | 7 | — | 2 | 6 | — | — | — | — | 2 | — | — | — | — | — | 1 |

Maxillary in head

| 2.40-2.50 | | | | | 2.50-2.60 | | | | | 2.60-2.70 | | | | | 2.70-2.80 | | | | | 2.80-2.90 | | | | | 2.90-3.00 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 1 | 7 | — | 1 | 1 | 26 | 17 | 2 | 1 | 3 | 13 | 15 | — | — | 4 | — | 2 | — | 2 | 1 | — | — | — | — | — | 1 | — | — | — | — |

Interorbital space in head

| 3.90–4.10 | | | | | 4.10–4.30 | | | | | 4.30–4.50 | | | | | 4.50–4.70 | | | | | 4.70–4.90 | | | | | 4.90–5.10 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | 8 | — | 1 | 7 | 9 | 18 | 1 | 3 | 2 | 17 | 12 | 1 | — | — | 10 | 3 | — | — | — | 4 | — | — | — | — | 1 | — | — | — | — |

Postorbital part of head in head

| 1.60–1.70 | | | | | 1.70–1.80 | | | | | 1.80–1.90 | | | | | 1.90–2.00 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | 4 | — | 2 | 6 | 34 | 34 | 2 | 1 | 3 | 7 | 2 | — | 1 | — | — | 1 | — | — | — |

Distance from origin of ventral to anal in body length

| 2.30–2.40 | | | | | 2.40–2.50 | | | | | 2.50–2.60 | | | | | 2.60–2.70 | | | | | 2.70–2.80 | | | | | 2.80–2.90 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | — | — | — | 1 | — | 1 | — | — | 6 | 4 | 8 | — | 1 | 2 | 11 | 13 | — | 1 | — | 21 | 11 | 1 | 2 | — | 5 | 8 | 1 | — | — |

Length of caudal peduncle in head

| 1.00–1.10 | | | | | 1.10–1.20 | | | | | 1.20–1.30 | | | | | 1.30–1.40 | | | | | 1.40–1.50 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | 1 | — | — | 1 | 10 | 6 | 2 | 3 | 7 | 19 | 28 | — | — | 1 | 12 | 5 | — | 1 | — | — | 1 | — | — | — |

Depth of caudal peduncle in head

| 2.90–3.00 | | | | | 3.00–3.10 | | | | | 3.10–3.20 | | | | | 3.20–3.30 | | | | | 3.30–3.40 | | | | | 3.40–3.50 | | | | | 3.50–3.60 | | | | | 3.60–3.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | 4 | — | — | — | 1 | 4 | — | 1 | 2 | 4 | 13 | — | — | 1 | 17 | 9 | 2 | 2 | 2 | 10 | 10 | — | — | 2 | 5 | 1 | — | 1 | 1 | 2 | — | — | — | 1 | 2 | — | — | — | — |

Pectoral in head

| 1.30–1.40 | | | | | 1.40–1.50 | | | | | 1.50–1.60 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 7 | 12 | — | — | 2 | 32 | 25 | 2 | 4 | 6 | 2 | 2 | — | — | 1 |

Ventral in head

| 1.20–1.30 | | | | | 1.30–1.40 | | | | | 1.40–1.50 | | | | | 1.50–1.60 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 2 | — | — | — | — | 24 | 16 | — | — | 1 | 14 | 21 | 2 | 2 | 6 | 1 | 4 | — | 2 | 2 |

Longest dorsal spine in head

| 1.60–1.70 | | | | | 1.70–1.80 | | | | | 1.80–1.90 | | | | | 1.90–2.00 | | | | | 2.00–2.10 | | | | | 2.10–2.20 | | | | | 2.20–2.30 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 1 | 1 | — | — | — | 9 | 7 | — | — | 1 | 17 | 7 | — | 1 | 5 | 12 | 6 | — | 3 | 2 | 1 | 12 | — | — | 1 | — | 3 | 1 | — | — | — | 2 | — | — | — |

Longest dorsal ray in head

| 2.00–2.10 | | | | | 2.10–2.20 | | | | | 2.20–2.30 | | | | | 2.30–2.40 | | | | | 2.40–2.50 | | | | | 2.50–2.60 | | | | | 2.60–2.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 1 | 1 | — | — | — | 10 | 7 | — | — | — | 21 | 16 | 1 | — | — | 8 | 14 | 1 | — | — | 1 | 3 | — | 1 | 3 | — | — | — | 3 | 3 | — | — | — | — | 3 |

Second anal spine in head

| 1.80–1.90 | | | | | 1.90–2.00 | | | | | 2.00–2.10 | | | | | 2.10–2.20 | | | | | 2.20–2.30 | | | | | 2.30–2.40 | | | | | 2.40–2.50 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | 1 | — | — | — | 4 | 4 | — | — | — | 12 | 7 | 1 | — | — | 19 | 13 | — | 1 | | 5 | 15 | 1 | — | — | 1 | 1 | — | 3 | 5 | — | — | — | — | 3 |

Longest anal ray in head

| 1.60–1.70 | | | | | 1.70–1.80 | | | | | 1.80–1.90 | | | | | 1.90–2.00 | | | | | 2.00–2.10 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| — | 2 | — | — | — | 15 | 7 | — | — | — | 18 | 19 | 1 | 1 | 1 | 8 | 12 | 1 | 2 | 4 | — | 1 | — | 1 | 4 |

Caudal in head

| 1.00–1.10 | | | | | 1.10–1.20 | | | | | 1.20–1.30 | | | | | 1.30–1.40 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 2 | — | — | — | — | 19 | 13 | 1 | | — | 15 | 15 | 1 | 2 | 4 | — | 1 | — | 2 | 5 |

Longest gill-raker on first arch in head

| 11.00–12.00 | | | | | 12.00–13.00 | | | | | 13.00–14.00 | | | | | 14.00–15.00 | | | | | 15.00–16.00 | | | | | 16.00–17.00 | | | | | 17.00–18.00 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| 4 | — | — | — | — | 13 | 3 | — | 1 | | 12 | 7 | — | — | — | 9 | 9 | 1 | 1 | 4 | 2 | 12 | 1 | 1 | 3 | 1 | 7 | — | 1 | — | — | 3 | — | — | 2 |

Number of pored scales on lateral line

| 47 | 48 | 49 | 50 | 51 | 52 | 53 |
|---|---|---|---|---|---|---|
| 2 | 8 | 18 | 23 | 26 | 15 | 5 |

| Number of soft dorsal rays | | | | |
|---|---|---|---|---|
| 27 | 28 | 29 | 30 | 31 |
| 4 | 22 | 37 | 24 | 10 |

| Number of pectoral rays | | | |
|---|---|---|---|
| 16 | 17 | 18 | 19 |
| 6 | 27 | 54 | 10 |

| Number of gill-rakers on first arch | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 7 | 11 | 12 | 27 | 20 | 16 | 3 | 1 |

Table IV. Frequencies of body proportions of *N. imbricata* MATSUBARA

| Sex | ♂ | ♀ | ♂ | ♀ | ♀ | ♀ | ♀ | ♀ | ♂ | ♂ | ♀ | ♀ | ♀ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total length (mm) | — | 529.5 | 518.0 | — | — | 500.5 | — | 484.0 | 461.0 | 429.0 | 426.0 | — | 373.0 |
| Body length (mm) | 448.5 | 440.0 | 434.0 | 430.0 | 427.0 | 421.5 | 414.0 | 401.0 | 381.0 | 353.0 | 349.0 | 346.8 | 305.0 |
| Scales | 55 | 53 | 56 | 56 | 56 | 53 | 55 | 55 | 55 | 53 | 55 | 54 | 53 |
| Dorsal | IX-I, 29 | IX-I, 27 | IX-I, 29 | IX-I, 29 | IX-I, 28 | IX-I, 28 | IX-I, 28 | IX-I, 29 | IX-I, 29 | IX-I, 30 | IX-I, 28 | IX-I, 28 | IX-I, 29 |
| Anal | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 | II,7 |
| Pectoral | 21 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 21 | 22 | 22 | 21 | 22 |
| Gill-rakers | 17 | 15 | 15 | 16 | 17 | 16 | 16 | 15 | 14 | 16 | 16 | 15 | 15 |
| Vertebrae | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Head in body length | 3.38 | 3.41 | 3.62 | 3.58 | 3.62 | 3.63 | 3.63 | 3.71 | 3.59 | 3.53 | 3.46 | 3.61 | 3.54 |
| Depth in body length | 4.72 | 4.44 | 5.06 | 4.78 | 4.91 | 5.08 | 4.76 | 5.35 | 5.16 | 4.51 | 5.01 | 4.56 | 4.59 |
| Dist. from origin of ventral to anal in head | 2.40 | 2.53 | 2.47 | 2.51 | 2.50 | 2.44 | 2.49 | 2.42 | 2.38 | 2.44 | 2.44 | 2.61 | 2.42 |
| Orbit in head | 5.45 | 5.38 | 5.38 | 5.22 | 5.62 | 5.47 | 5.23 | 5.22 | 5.17 | 5.26 | 5.10 | 5.27 | 5.07 |
| Snout in head | 4.60 | 4.37 | 4.32 | 4.38 | 4.24 | 4.13 | 4.38 | 4.50 | 4.51 | 4.50 | 4.39 | 4.57 | 4.33 |
| Maxillary in head | 2.30 | 2.35 | 2.33 | 2.26 | 2.29 | 2.36 | 2.26 | 2.26 | 2.33 | 2.30 | 2.23 | 2.26 | 2.30 |
| Interorbital space in head | 4.91 | 5.06 | 4.96 | 4.80 | 4.76 | 4.64 | 4.56 | 4.74 | 4.71 | 4.88 | 4.76 | 4.57 | 4.61 |
| Postorbital part of head in head | 1.59 | 1.65 | 1.67 | 1.65 | 1.64 | 1.63 | 1.64 | 1.67 | 1.63 | 1.64 | 1.68 | 1.67 | 1.66 |
| Length of caudal peduncle in head | 1.29 | 1.16 | 1.22 | 1.20 | 1.26 | 1.18 | 1.17 | 1.17 | 1.24 | 1.30 | 1.25 | 1.14 | 1.34 |
| Depth of caudal peduncle in head | 3.81 | 3.79 | 3.64 | 3.69 | 3.58 | 3.63 | 3.45 | 3.72 | 3.44 | 3.47 | 3.54 | 3.56 | 3.43 |
| Pectoral in head | 1.46 | 1.59 | 1.52 | 1.55 | 1.51 | 1.59 | — | 1.44 | 1.45 | 1.46 | 1.42 | 1.41 | 1.45 |
| Longest dorsal spine in head | — | — | 2.64 | 2.53 | — | — | — | 2.71 | 2.46 | 2.58 | 2.64 | 2.63 | — |
| Longest dorsal ray in head | 2.88 | — | 2.80 | 2.94 | 2.88 | 3.01 | 2.75 | 2.67 | 2.75 | 2.94 | 2.73 | 2.63 | 2.60 |
| Second anal spine in head | 4.42 | — | 4.29 | 4.60 | 4.68 | 5.04 | 4.25 | 4.48 | 4.61 | 4.52 | 4.45 | 5.00 | 4.66 |
| Longest anal ray in head | 2.45 | 2.58 | 2.40 | 2.58 | 2.54 | 2.64 | 2.33 | 2.35 | 2.30 | 2.48 | 2.48 | 2.35 | 2.32 |
| Ventral in head | 1.79 | 1.98 | 1.76 | 1.98 | 1.93 | 2.05 | 1.87 | 1.89 | 1.83 | 1.86 | 1.88 | 1.93 | 1.72 |
| Caudal in head | — | 1.43 | 1.30 | — | — | 1.36 | — | 1.21 | 1.28 | 1.25 | 1.26 | — | 1.15 |
| Longest gill-raker in head | 14.56 | 16.54 | 13.33 | 15.00 | 13.26 | 14.50 | 14.80 | 13.50 | 14.13 | 13.33 | 15.54 | 13.71 | 12.49 |

Table V. Frequencies of body proportions of *Nibea argentata* (Houttuyn)

Loc.: A, China Sea; B, Sinabara; C, Miya.
Age: I, one year; II, two year, and III, three years old.

| Loc. | Head in body length | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.80–2.90 | | | 2.90–3.00 | | | 3.00–3.10 | | | 3.10–3.20 | | | 3.20–3.30 | | | 3.30–3.40 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | — | — | — | — | — | — | 6 | 2 | — | 60 | 5 | 3 | 34 | 5 | 2 | 5 | 1 | 1 |
| B | — | — | — | 2 | 1 | 5 | 7 | 3 | 7 | 4 | 8 | 11 | 3 | 1 | 1 | — | — | — |
| C | — | 1 | — | — | 11 | — | — | 27 | 3 | — | 15 | 1 | — | — | — | — | — | — |

| Loc | Depth in body length | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.00–3.10 | | | 3.10–3.20 | | | 3.20–3.30 | | | 3.30–3.40 | | | 3.40–3.50 | | | 3.50–3.60 | | | 3.60–3.70 | | | 3.70–3.80 | | | 3.80–3.90 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | — | 1 | — | 1 | — | 1 | 1 | — | 1 | 14 | — | 2 | 26 | 1 | 2 | 36 | 5 | — | 13 | 1 | — | 12 | 3 | — | 2 | 2 | — |
| B | — | — | — | — | — | — | 1 | 1 | 1 | 9 | 6 | 4 | 3 | 5 | 13 | 3 | 1 | 6 | — | — | — | — | — | — | — | — | — |
| C | — | — | — | — | 2 | — | — | 4 | — | — | 17 | 2 | — | 14 | — | — | 9 | 2 | — | 3 | — | — | 4 | — | — | 1 | — |

| Loc. | Snout in head | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.40–3.60 | | | 3.60–3.80 | | | 3.80–4.00 | | | 4.00–4.20 | | | 4.20–4.40 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 9 | 3 | 2 | 55 | 6 | 2 | 36 | 4 | 2 | 5 | — | — | — | — | — |
| B | — | — | 2 | 9 | 10 | 14 | 6 | 3 | 7 | 1 | — | 1 | — | — | — |
| C | — | — | — | — | 4 | — | — | 23 | 3 | — | 23 | — | — | 3 | 2 |

| Loc. | Orbit in head | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.90–4.10 | | | 4.10–4.30 | | | 4.30–4.50 | | | 4.50–4.70 | | | 4.70–4.90 | | | 4.90–5.10 | | | 5.10–5.30 | | | 5.30–5.50 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 2 | 1 | — | 12 | — | 2 | 49 | 4 | 1 | 35 | 3 | 2 | 7 | 5 | 1 | — | — | — | — | — | — | — | — | — |
| B | — | — | — | 3 | — | — | 7 | 5 | 4 | 4 | 5 | 12 | 1 | 3 | 7 | 1 | — | 1 | — | — | — | — | — | — |
| C | — | — | — | — | — | — | — | 7 | — | — | 12 | 2 | — | 20 | — | — | 13 | 1 | 1 | — | — | — | 1 | 1 |

| Loc. | Maxillary in head | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.10–2.20 | | | 2.20–2.30 | | | 2.30–2.40 | | | 2.40–2.50 | | | 2.50–2.60 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 5 | 1 | 2 | 58 | 4 | 3 | 41 | 8 | 1 | 1 | — | — | — | — | — |
| B | 1 | 2 | 2 | 9 | 7 | 9 | 5 | 3 | 13 | 1 | — | — | — | — | — |
| C | — | — | — | — | 15 | 1 | — | 27 | 2 | — | 12 | — | — | — | 1 |

| Loc. | Interorbital space in head | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.20-3.30 | | | 3.30-3.40 | | | 3.40-3.50 | | | 3.50-3.60 | | | 3.60-3.70 | | | 3.70-3.80 | | | 3.80-3.90 | | | 3.90-4.00 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 2 | — | 2 | 7 | — | 2 | 23 | 4 | 1 | 34 | 4 | — | 22 | 3 | 1 | 8 | 1 | — | 6 | 1 | — | 3 | — | — |
| B | — | 1 | — | — | — | — | 2 | 3 | 1 | 7 | 4 | 7 | 2 | 3 | 8 | 5 | 2 | 6 | — | — | 1 | — | — | 1 |
| C | — | — | — | — | 1 | — | — | 13 | — | — | 18 | 1 | — | 13 | 1 | — | 6 | 1 | — | 3 | 1 | — | — | — |

| Loc. | Postorbital part of head in head | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.70-1.75 | | | 1.75-1.80 | | | 1.80-1.85 | | | 1.85-1.90 | | | 1.90-1.95 | | | 1.95-2.00 | | | 2.00-2.05 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | — | — | — | 6 | 3 | 1 | 55 | 7 | 4 | 36 | 2 | — | 8 | — | — | — | — | 1 | — | 1 | — |
| B | — | — | 1 | 1 | 1 | 5 | 6 | 8 | 11 | 8 | 3 | 4 | 1 | 1 | 2 | — | — | 1 | — | — | — |
| C | — | 4 | 1 | — | 21 | 1 | — | 23 | 2 | — | 5 | — | — | 1 | — | — | — | — | — | — | — |

| Loc. | Distance from origin of ventral to anal in body length | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.40-2.50 | | | 2.50-2.60 | | | 2.60-2.70 | | | 2.70-2.80 | | | 2.80-2.90 | | | 2.90-3.00 | | | 3.00-3.10 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 10 | 5 | 2 | 18 | 2 | — | 46 | 3 | 3 | 28 | 3 | 1 | 2 | — | — | 1 | — | — | — | — | — |
| B | — | — | 1 | — | 2 | 1 | 1 | 10 | 6 | 5 | 1 | 10 | 6 | — | 5 | 1 | — | 1 | 3 | — | — |
| C | — | 2 | — | — | 11 | 1 | — | 13 | 3 | — | 17 | — | — | 11 | — | — | — | — | — | — | — |

| Loc. | Length of caudal peduncle in head | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.20-1.30 | | | 1.30-1.40 | | | 1.40-1.50 | | | 1.50-1.60 | | | 1.60-1.70 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 3 | 2 | 1 | 26 | 4 | 1 | 57 | 4 | 3 | 15 | 3 | 1 | 4 | — | — |
| B | — | — | — | 3 | 3 | 2 | 8 | 6 | 13 | 4 | 4 | 6 | 1 | — | 3 |
| C | — | — | — | — | — | — | — | 24 | 1 | — | 20 | 2 | — | 10 | 1 |

| Loc. | Depth of caudal peduncle in head | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.80-3.00 | | | 3.00-3.20 | | | 3.20-3.40 | | | 3.40-3.60 | | | 3.60-3.80 | | | 3.80-3.90 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 4 | — | 1 | 41 | 6 | 4 | 49 | 7 | — | 11 | — | 1 | — | — | — | — | — | — |
| B | — | — | — | 2 | 1 | 3 | 9 | 8 | 13 | 5 | 4 | 8 | — | — | — | [illegible] | | — |
| C | — | — | — | — | — | — | — | 14 | 1 | — | 25 | 3 | — | 14 | — | — | 1 | — |

| Loc. | Pectoral in head | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.00–1.10 | | | 1.10–1.20 | | | 1.20–1.30 | | | 1.30–1.40 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III |
| A | — | — | 1 | 32 | 5 | — | 69 | 7 | 2 | 1 | 2 | 3 |
| B | — | — | — | 2 | 3 | 12 | 13 | 10 | 10 | 1 | — | 2 |
| C | — | — | 1 | — | 18 | 1 | — | 30 | 2 | — | 6 | — |

| Loc. | Ventral in head | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.40–1.50 | | | 1.50–1.60 | | | 1.60–1.70 | | | 1.70–1.80 | | | 1.80–1.90 | | | 1.90–2.00 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 44 | 6 | 2 | 49 | 5 | 4 | 8 | 2 | — | 2 | — | — | — | — | — | — | — | — |
| B | — | — | 2 | 4 | 4 | 6 | 11 | 7 | 13 | 1 | 2 | 2 | — | — | — | — | — | 1 |
| C | — | 4 | — | | 22 | 2 | — | 21 | 1 | — | 7 | 1 | — | — | | | | |

| Loc. | Longest dorsal spine in head | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.10–2.20 | | | 2.20–2.30 | | | 2.30–2.40 | | | 2.40–2.50 | | | 2.50–2.60 | | | 2.60–2.70 | | | 2.70–2.80 | | | 2.80–2.90 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 4 | 1 | — | 5 | 1 | — | 17 | 3 | 1 | 20 | 4 | 3 | 26 | — | 1 | 10 | 1 | | 6 | — | — | 1 | — | — |
| B | — | 1 | — | 2 | 1 | 3 | 8 | 5 | 3 | 2 | 3 | 7 | 2 | 1 | 8 | 1 | 1 | 1 | — | — | — | — | 1 | 1 |
| C | — | 2 | — | — | 7 | — | — | 13 | — | | 17 | 2 | — | 8 | 2 | — | 3 | — | | 3 | | — | — | — |

| Loc. | Longest dorsal ray in head | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.20–2.30 | | | 2.30–2.40 | | | 2.40–2.50 | | | 2.50–2.60 | | | 2.60–2.70 | | | 2.70–2.80 | | | 2.80–2.90 | | | 2.90–3.00 | | | 3.00–3.10 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 6 | — | — | 25 | 3 | 2 | 41 | 2 | 1 | 23 | 6 | 2 | 7 | 1 | 1 | 1 | — | — | — | — | — | — | — | — | — | — | — |
| B | | — | | | — | | 1 | — | — | 1 | — | 1 | 8 | 3 | 2 | 5 | 6 | 4 | | 2 | 7 | 1 | 2 | 7 | | | — |
| C | — | — | — | — | — | — | — | — | — | — | 7 | | — | 12 | — | — | 8 | 2 | | 12 | | — | 7 | 1 | — | 5 | — |

| Loc. | Second anal spine in head | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.70–4.00 | | | 4.00–4.30 | | | 4.30–4.60 | | | 4.60–4.90 | | | 4.90–5.20 | | | 5.20–5.50 | | | 5.50–5.80 | | | 5.80–6.10 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 1 | 1 | — | 26 | 1 | — | 39 | 4 | 2 | 31 | 4 | 2 | 3 | 1 | 1 | 1 | — | 1 | — | — | — | — | — | — |
| B | — | — | — | 2 | — | — | 6 | — | 1 | 6 | 7 | 10 | 2 | 4 | 6 | — | 1 | 6 | — | 1 | — | — | — | 1 |
| C | — | 2 | — | — | 3 | — | — | 10 | — | — | 18 | — | — | 15 | 3 | — | 3 | — | — | — | 1 | — | — | — |

| Loc. | Longest anal ray in head | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.00–2.10 | | | 2.10–2.20 | | | 2.20–2.30 | | | 2.30–2.40 | | | 2.40–2.50 | | | 2.50–2.60 | | | 2.60–2.70 | | | 2.70–2.80 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 8 | 2 | — | 45 | 2 | 1 | 32 | 6 | 1 | 13 | 2 | 3 | 2 | — | — | — | — | 1 | | — | — | — | — | — |
| B | — | — | — | — | — | — | 1 | — | — | 5 | 3 | 5 | 5 | 5 | 10 | 3 | 4 | 5 | 2 | — | 3 | — | 1 | 1 |
| C | — | — | | — | 2 | — | — | 3 | — | — | 18 | 1 | — | 17 | 2 | — | 13 | 1 | — | — | — | — | — | — |

| Loc | Caudal in head | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.00–1.10 | | | 1.10–1.20 | | | 1.20–1.30 | | | 1.30–1.40 | | | 1.40–1.50 | | | 1.50–1.60 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 1 | — | — | 8 | 2 | — | 64 | 5 | 1 | 27 | 6 | 4 | 3 | — | — | — | — | 1 |
| B | — | | — | — | | — | — | — | 1 | 12 | 6 | 5 | 4 | 5 | 16 | — | 1 | — |
| C | — | — | | | — | | — | 17 | | — | 29 | 3 | — | 6 | 1 | — | 1 | — |

| Loc. | Longest gill-raker on first arch in head | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9.00–10.00 | | | 10.00–11.00 | | | 11.00–12.00 | | | 12.00–13.00 | | | 13.00–14.00 | | | 14.00–15.00 | | |
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| A | 3 | — | — | 19 | 1 | 2 | 42 | 5 | 1 | 33 | 3 | — | 6 | 3 | 3 | 2 | 1 | — |
| B | — | 1 | — | 3 | 3 | 3 | 11 | 5 | 6 | 1 | 3 | 7 | 1 | — | 4 | — | 1 | 4 |
| C | — | 5 | | — | 23 | 1 | — | 22 | — | — | 1 | 2 | — | 3 | 1 | — | — | — |

| Loc. | Number of pored scales on lateral line | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 54 | 52 |
| A | — | — | 3 | — | 10 | 20 | 32 | 40 | 19 | 3 |
| B | — | 1 | 3 | 7 | 11 | 10 | 20 | 7 | — | — |
| C | 1 | 8 | 9 | 11 | 16 | 11 | 5 | 2 | — | — |

| Loc. | Number of soft dorsal rays | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| A | — | — | 6 | 35 | 52 | 27 | 7 | 1 |
| B | — | 1 | 11 | 20 | 19 | 8 | — | — |
| C | 6 | 16 | 22 | 18 | 1 | — | — | — |

| Loc. | Number of soft anal rays | | |
|---|---|---|---|
| | 6 | 7 | 8 |
| A | — | 60 | 3 |
| B | 1 | 56 | 2 |
| C | 1 | 44 | 18 |

| Loc. | Number of pectoral rays | | | | |
|---|---|---|---|---|---|
| | 14 | 15 | 16 | 17 | 18 |
| A | 1 | 1 | 19 | 74 | 33 |
| B | — | 1 | 6 | 37 | 15 |
| C | — | — | 16 | 41 | 6 |

| Loc. | Number of gill-rakers on first arch | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Average |
| A | 2 | 15 | 51 | 44 | 15 | — | 1 | — |
| B | 1 | — | 7 | 25 | 20 | 6 | — | — |
| C | — | 1 | 10 | 29 | 17 | 4 | 2 | — |

Table VI. Frequencies of body proportions of *Nibea nibe* (JORDAN & THOMPSON).

Loc.: A, China Sea; B, Miya.
Age: I, one year; II, two years; III, three years; IV, four years; V, five years; VI, six years and VII, seven years old.

| Loc. | Head in body length | | | | | | |

Orbit in head

| Loc. | 3.80–4.10 | | | | | | | 4.10–4.40 | | | | | | | 4.40–4.70 | | | | | | | 4.70–5.00 | | | | | | | 5.00–5.30 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | – | – | 1 | – | – | – | – | – | – | 3 | 3 | 1 | – | 1 | – | – | 2 | – | – | 1 | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – |
| B | 3 | – | – | – | – | – | – | 6 | 3 | – | – | – | – | – | 3 | 1 | – | – | 1 | – | – | – | – | – | – | 1 | 2 | 1 | – | – | – | – | – | – | 1 | 1 |

Maxillary in head

| Loc. | 2.10–2.20 | | | | | | | 2.20–2.30 | | | | | | | 2.30–2.40 | | | | | | | 2.40–2.50 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | – | – | 1 | – | – | – | – | – | – | 2 | 2 | 1 | – | 1 | – | – | 3 | 1 | – | 1 | 1 | – | – | – | – | – | – | – |
| B | – | – | – | – | – | – | – | 5 | 1 | – | – | 1 | – | – | 7 | 2 | – | – | 1 | 2 | 2 | – | 1 | – | – | – | 1 | – |

Interorbital space in head

| Loc. | 3.50–3.70 | | | | | | | 3.70–3.90 | | | | | | | 3.90–4.10 | | | | | | | 4.10–4.30 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | – | – | – | – | – | – | – | – | – | 3 | 1 | 1 | – | – | – | – | 3 | 2 | – | – | – | – | – | – | – | – | – | 1 | 2 |
| B | 3 | – | – | – | – | – | 1 | 4 | 1 | – | – | – | – | 1 | 3 | 3 | – | – | 2 | 1 | – | 2 | – | – | – | – | 2 | – |

Postorbital part of head in head

| Loc | 1.70–1.80 | | | | | | | 1.80–1.90 | | | | | | | 1.90–2.00 | | | | | | | 2.00–2.10 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VI |
| A | – | – | – | – | – | – | – | – | – | 5 | 1 | – | 1 | 1 | – | – | – | 2 | 1 | – | – | – | – | 1 | – | – | – | 1 |
| B | – | – | – | – | – | 1 | – | 6 | 3 | – | – | 2 | 2 | 2 | 6 | 1 | – | – | – | – | – | – | – | – | – | – | – | – |

Distance from origin of ventral to anal in body length

| Loc. | 2.30–2.40 | | | | | | | 2.40–2.50 | | | | | | | 2.50–2.60 | | | | | | | 2.60–2.70 | | | | | | | 2.70–2.80 | | | | | | | 2.80–2.90 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | – | – | – | – | – | 1 | – | – | – | 1 | 1 | 1 | – | 1 | – | – | 3 | 1 | – | – | 1 | – | – | – | 1 | – | – | – | – | – | 1 | – | – | – | – | – | – | 1 | – | – | – | – |
| B | – | – | – | – | – | – | – | 1 | – | – | – | 1 | 2 | 1 | 5 | – | – | – | 1 | 1 | – | 1 | 2 | – | – | – | – | 1 | 5 | 1 | – | – | – | – | – | – | 1 | – | – | – | – | – |

Length of caudal peduncle in head

| Loc. | 1.10–1.20 | | | | | | | 1.20–1.30 | | | | | | | 1.30–1.40 | | | | | | | 1.40–1.50 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| B | – | – | 2 | – | – | – | – | – | – | 2 | 3 | 1 | – | 1 | – | 2 | – | – | – | 1 | 1 | – | – | – | – | – | – | – | – |
| A | – | – | – | – | – | – | 1 | 8 | 1 | – | – | 1 | 1 | – | 4 | 3 | – | – | 1 | 1 | – | – | – | – | – | – | 1 | 1 |

Depth of caudal peduncle in head

| Loc | 3.00-3.20 | | | | | | | 3.20-3.40 | | | | | | | 3.40-3.60 | | | | | | | 3.60-3.80 | | | | | | | 3.80-4.00 | | | | | | | 4.00-4.20 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | | | 1 | | | | | | | 3 | 2 | | | 1 | | | 2 | 1 | 1 | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | |
| B | 2 | 1 | | | | | | 9 | 3 | | | | | | 1 | | | 2 | | | | | | | | | | 1 | | | | | | 1 | | | | | | 2 | 1 | | |

Length of pectoral in head

| Loc | 1.00-1.10 | | | | | | | 1.10-1.20 | | | | | | | 1.20-1.30 | | | | | | | 1.30-1.40 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | | | | | | | | | 2 | | | | | | | | 2 | 3 | | | 1 | | | 2 | | 1 | 1 | 1 |
| B | 1 | | | | | | 1 | 9 | 1 | | | 2 | | | 2 | 3 | | | | 3 | 1 | | | | | | | | |

Ventral in head

| Loc | 1.40-1.50 | | | | | | | 1.50-1.60 | | | | | | | 1.60-1.70 | | | | | | | 1.70-1.80 | | | | | | | 1.80-1.90 | | | | | | | 1.90-2.00 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | | | | | | | | | | | | | | | | 1 | | | | | | | 4 | 3 | 1 | | | | | | 1 | | | 1 | 1 | | | | | | | 1 |
| B | 2 | | | | | | | 8 | 1 | | | | | | 1 | 1 | | | | | 1 | 1 | 2 | | | | | | | | | 2 | 2 | | | | | | | 1 | 1 |

Longest dorsal spine in head

| Loc | 2.10-2.30 | | | | | | | 2.30-2.50 | | | | | | | 2.50-2.70 | | | | | | | 2.70-2.90 | | | | | | | 2.90-3.10 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | | | | | | | | | | 1 | | | | | | | 2 | 1 | 1 | 1 | 1 | | | 1 | 1 | | | 1 | | | 1 | | | | | | |
| B | 7 | | | | | | | 4 | 2 | | | | | | 1 | 2 | | | 1 | 1 | 2 | | | | | 1 | 1 | | | | | | | | | | |

Longest dorsal ray in head

| Loc | 2.20-2.40 | | | | | | | 2.40-2.60 | | | | | | | 2.60-2.80 | | | | | | | 2.80-3.00 | | | | | | | 3.00-3.20 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | | | | | | | | | 1 | | | | | | | 3 | 2 | 1 | | 1 | | | | 1 | | | | | | | | | | | 1 | 1 | |
| B | 10 | | | | | | | 2 | 1 | | | | | | | 2 | | | 2 | 2 | | | 1 | | | | | | | | | | | | | | 1 |

Second anal spine in head

| Loc | 4.00-4.50 | | | | | | | 4.50-5.00 | | | | | | | 5.00-5.50 | | | | | | | 5.50-6.00 | | | | | | | 6.00-6.50 | | | | | | | 6.50-7.00 | | | | | | | 7.00-7.50 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | | | | | | | | | 2 | | | | | | | 3 | 2 | | | | | | | 1 | 1 | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | |
| B | 1 | | | | | | | 11 | 1 | | | | | | | 2 | | | | | | | 1 | | | | | | | | | 1 | 2 | | | | | | 1 | 1 | | | | | | | | | | | 2 |

Longest anal ray in head

| Loc. | 2.00–2.20 | | | | | | | 2.20–2.40 | | | | | | | 2.40–2.60 | | | | | | | 2.60–2.80 | | | | | | | 2.80–3.00 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | 4 | 1 | – | – | 1 | – | – | 1 | 1 | 1 | – | 1 | – | – | – | – | – | – | 1 | – |
| B | 6 | – | – | – | – | – | – | 5 | 1 | – | – | – | – | – | 1 | 1 | – | – | – | – | – | – | 1 | – | – | 2 | 1 | 1 | – | – | – | – | – | – | – | 1 |

Caudal in head

| Loc. | 1.00–1.10 | | | | | | | 1.10–1.20 | | | | | | | 1.20–1.30 | | | | | | | 1.30–1.40 | | | | | | | 1.40–1.50 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | 3 | 2 | 1 | – | 1 | – | – | 2 | 1 | – | 1 | – | – | – | – | – | – | – | – | 1 |
| B | 5 | – | – | – | – | – | – | 6 | 2 | – | – | – | – | – | – | 2 | – | – | 2 | 2 | 1 | 1 | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – |

Longest gill-raker on first arch in head

| Loc | 8.00–9.00 | | | | | | | 9.00–10.00 | | | | | | | 10.00–11.00 | | | | | | | 11.00–12.00 | | | | | | | 12.00–13.00 | | | | | | | 13.00–14.00 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII | I | II | III | IV | V | VI | VII |
| A | – | – | 2 | 1 | – | – | – | – | – | 2 | 1 | 1 | – | – | – | – | 2 | 1 | – | 1 | – | – | – | – | – | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| B | 2 | 1 | – | – | – | – | – | 8 | 2 | – | – | – | – | – | 1 | – | – | – | 2 | 1 | 1 | 1 | 1 | – | – | – | 1 | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | 1 |

| Loc. | Number of scales on lateral line | | | | | | |
|---|---|---|---|---|---|---|---|
| | 49 | 50 | 51 | 52 | 53 | 54 | 55 |
| A | — | 1 | 4 | 3 | 4 | — | — |
| B | 1 | 8 | 9 | 4 | — | — | 1 |

| Loc. | Number of soft dorsal rays | | | | | |
|---|---|---|---|---|---|---|
| | 27 | 28 | 29 | 30 | 31 | 32 |
| A | — | 1 | 1 | 5 | 5 | 1 |
| B | 2 | 3 | 12 | 6 | — | — |

| Loc. | Number of pectoral rays | | |
|---|---|---|---|
| | 16 | 17 | 18 |
| A | — | 10 | 3 |
| B | 2 | 20 | 1 |

| Loc. | Number of gill-rakers on first arch | | | |
|---|---|---|---|---|
| | 15 | 16 | 17 | 18 |
| A | — | 7 | 5 | 1 |
| B | 1 | 4 | 16 | 2 |

Table VII. Frequencies of body proportions of *Pseudosciaena crocea* (RICHARDSON)

Locality: A. Huzan; B, China Sea.
Age: II, two years; III, three years; IV, four years; V, five years, and VI, six years old.

Head in body length

| Loc | 3.40-3.50 | | | | | 3.50-3.60 | | | | | 3.60-3.70 | | | | | 3.70-3.80 | | | | | 3.80-3.90 | | | | | 3.90-4.00 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | 1 | 3 | — | — | — | 2 | 5 | 4 | — | — | 2 | 2 | 4 | 1 | — | — | — | 5 | — | 1 | — | — | 4 | 1 | 1 | — | — | 2 | 1 | — |
| B | — | — | — | — | 3 | — | — | — | — | 1 | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

Depth in body length

| Loc. | 3.50-3.70 | | | | | 3.70-3.90 | | | | | 3.90-4.10 | | | | | 4.10-4.30 | | | | | 4.30-4.50 | | | | | 4.50-4.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | 1 | — | 3 | — | — | 2 | 4 | — | — | — | 2 | 5 | 5 | 2 | — | — | 1 | 6 | 1 | — | — | — | 5 | — | — | — | — | — | — | 2 |
| B | — | — | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | 3 | — | — | — | — | — |

Snout in head

| Loc | 4.30-4.40 | | | | | 4.40-4.50 | | | | | 4.50-4.60 | | | | | 4.60-4.70 | | | | | 4.70-4.80 | | | | | 4.80-4.90 | | | | | 4.90-5.00 | | | | | 5.00-5.10 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | — | 1 | — | — | 2 | 1 | 1 | — | — | — | 4 | 4 | 2 | — | 1 | 1 | 2 | — | — | 2 | 2 | 7 | 1 | — | - | 1 | 3 | - | 1 | - | - | 1 | - | 1 | - | 1 | - | - | - |
| B | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | 1 | — | — | — | — | — | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Orbit in head

| Loc. | 4.20-4.40 | | | | | 4.40-4.60 | | | | | 4.60-4.80 | | | | | 4.80-5.00 | | | | | 5.00-5.20 | | | | | 5.20-5.40 | | | | | 5.40-5.60 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | 4 | 3 | — | — | — | — | 5 | — | — | — | — | 1 | 1 | — | — | 1 | — | 1 | — | — | — | — | 4 | 3 | 1 | — | 1 | 9 | — | — | — | — | 4 | — | 1 |
| B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | 1 | — | — | — | — | 2 | — | — | — | — | 1 |

Maxillary in head

| Loc. | 1.90-2.00 | | | | | 2.00-2.10 | | | | | 2.10-2.20 | | | | | 2.20-2.30 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | 2 | 1 | — | 1 | — | 2 | 8 | 15 | 2 | 1 | 1 | 1 | 3 | — | 1 | — | — | 1 | — | — |
| B | — | — | — | — | 1 | — | — | — | — | 4 | — | — | — | — | 1 | — | — | — | — | — |

Interorbital space in head

| Loc | 2.90-3.00 | | | | | 3.00-3.10 | | | | | 3.10-3.20 | | | | | 3.20-3.30 | | | | | 3.30-3.40 | | | | | 3.40-3.50 | | | | | 3.50-3.60 | | | | | 3.60-3.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | 1 | — | — | — | 2 | 2 | 1 | 1 | — | 2 | 4 | 1 | — | — | 1 | 3 | 2 | — | — | — | — | 5 | 1 | 1 | — | — | — | 5 | 1 | 1 | — | — | 3 | — | — | — | — | 2 | — | — |
| B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — |

Postorbital part of head in head

| Loc | 1.50-1.60 | | | | | 1.60-1.70 | | | | | 1.70-1.80 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | — | 2 | — | — | — | 2 | 16 | 3 | 2 | 5 | 8 | 1 | — | — |
| B | — | — | — | — | — | — | — | — | — | 6 | — | — | — | — | — |

Distance from origin of ventral to anal in body length

| Loc. | 2.10-2.20 | | | | | 2.20-2.30 | | | | | 2.30-2.40 | | | | | 2.40-2.50 | | | | | 2.50-2.60 | | | | | 2.60-2.70 | | | | | 2.70-2.80 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | VI | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | — | 1 | — | — | — | — | 3 | — | — | — | 1 | 7 | — | 1 | 3 | — | 5 | 3 | 1 | 1 | 5 | 2 | — | — | 1 | 3 | — | — | — | — | 1 | 1 | — | — |
| B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | 3 | — | — | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — |

Length of caudal peduncle in head

| Loc. | 1.00-1.10 | | | | | 1.10-1.20 | | | | | 1.20-1.30 | | | | | 1.30-1.40 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | 1 | 8 | 3 | 2 | 4 | 2 | 11 | — | — | — | 6 | — | — | — | 1 | 1 | — | — | — |
| B | — | — | — | — | — | — | — | — | — | 5 | — | — | — | — | 1 | — | — | — | — | — |

Depth of caudal peduncle in head

| Loc. | 3.30-3.50 | | | | | 3.50-3.70 | | | | | 3.70-3.90 | | | | | 3.90-4.10 | | | | | 4.10-4.30 | | | | | 4.30-4.50 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | 2 | 3 | 2 | 1 | — | 3 | 6 | 5 | 1 | — | — | 1 | 8 | 1 | 1 | — | — | 3 | — | — | — | — | 1 | — | 1 | — | — | — | — | — |
| B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 2 |

Pectoral in head

| Loc. | 1.10-1.20 | | | | | 1.20-1.30 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | 1 | 10 | 3 | 1 | 4 | 9 | 9 | — | 1 |
| B | — | — | — | — | 1 | — | — | — | — | 2 |

| Loc. | Ventral in head | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.30–1.40 | | | | | 1.40–1.50 | | | | | 1.50–1.60 | | | | |
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | 1 | — | — | — | — | 4 | 7 | 12 | 2 | 2 | — | 3 | 7 | 1 | — |
| B | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | 2 |

| Loc. | Longest dorsal spine in head | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.20–2.30 | | | | | 2.30–2.40 | | | | | 2.40–2.50 | | | | | 2.50–2.60 | | | | | 2.60–2.70 | | | | | 2.70–2.80 | | | | | 2.80–2.90 | | | | |
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | — | 1 | — | — | — | 1 | — | — | — | — | 1 | 1 | 1 | — | 2 | 1 | 7 | 1 | — | — | 1 | 4 | — | 2 | 1 | 2 | 1 | 1 | — | — | 1 | — | — | — |
| B | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 |

| Loc. | Longest dorsal ray in head | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.80–1.90 | | | | | 1.90–2.00 | | | | | 2.00–2.10 | | | | | 2.10–2.20 | | | | | 2.20–2.30 | | | | | 2.30–2.40 | | | | | 2.40–2.50 | | | | |
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI |
| A | — | — | 1 | — | — | — | 1 | — | — | — | 1 | 2 | 3 | 1 | — | 2 | 3 | 6 | 1 | 1 | — | 4 | 8 | — | — | 1 | — | 1 | — | — | — | — | — | — | 1 |
| B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | 1 | — | — | — | — | — | 1 | — | — | — | — | 1 |

| Loc. | Second anal spine in head | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4.00–4.50 | | | | | 4.50–5.00 | | | | | 5.00–5.50 | | | | | 5.50–6.00 | | | | | | | | | |
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | | | | | |
| A | 3 | 3 | 1 | — | — | 2 | 5 | 10 | 1 | — | — | 2 | 8 | 1 | 1 | — | — | — | 1 | 1 | | | | | |
| B | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | 1 | — | — | — | — | 1 | | | | | |

| Loc. | Longest anal ray in head | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.70–1.80 | | | | | 1.80–1.90 | | | | | 1.90–2.00 | | | | | 2.00–2.10 | | | | | | | | | |
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | | | | | |
| A | 4 | 4 | 1 | — | — | — | 2 | 6 | 1 | — | 1 | 4 | 7 | 1 | 1 | — | — | 4 | 1 | 1 | | | | | |
| B | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | 1 | — | — | — | — | 2 | | | | | |

| Loc. | Caudal in head | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.90–1.00 | | | | | 1.00–1.10 | | | | | 1.10–1.20 | | | | | 1.20–1.30 | | | | | | | | | |
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | II | III | IV | V | VI | | | | | |
| A | — | 2 | — | — | — | 5 | 7 | 4 | 1 | — | — | 1 | 13 | 1 | 1 | — | — | 2 | — | — | | | | | |
| B | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | 1 | | | | | |

| Loc. | Longest gill-raker on first arch in head | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7.00-8.00 | | | | | 8.00-9.00 | | | | | 9.00-10.00 | | | | | 10.00-11.00 | | | | |
| | II | III | IV | V | VI | II | III | IV | V | VI | II | III | V | IV | VI | II | III | IV | V | VI |
| A | 3 | 5 | 1 | — | — | 1 | 3 | 8 | 1 | — | 1 | 2 | 8 | 2 | 1 | — | — | 2 | — | 1 |
| B | — | — | — | — | 1 | — | — | — | — | 2 | — | | — | — | 2 | — | — | — | — | 1 |

| Loc. | Number of scales on lateral line | | | | | |
|---|---|---|---|---|---|---|
| | 51 | 52 | 53 | 54 | 55 | 56 |
| A | 1 | 7 | 16 | 12 | 2 | 1 |
| B | — | — | 4 | 1 | 2 | 1 |

| Loc | Number of soft dorsal rays | | | | | |
|---|---|---|---|---|---|---|
| | 30 | 31 | 32 | 33 | 34 | 35 |
| A | 2 | 6 | 7 | 16 | 7 | 1 |
| B | — | 3 | 1 | 3 | 1 | — |

| Loc. | Number of soft anal rays | | |
|---|---|---|---|
| | 7 | 8 | 9 |
| A | 1 | 34 | 4 |
| B | — | 8 | — |

| Loc. | Number of pectoral rays | | |
|---|---|---|---|
| | 16 | 17 | 18 |
| A | 7 | 28 | 4 |
| B | 1 | 6 | 1 |

| Loc. | Number of gill-rakers on first arch | | | | | | |
|---|---|---|---|---|---|---|---|
| | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| A | — | 4 | 12 | 19 | 4 | — | — |
| B | 1 | — | 2 | 2 | 2 | — | 1 |

| Loc. | Number of vertebrae (including hypural) | |
|---|---|---|
| | 25 | 26 |
| A | 2 | 37 |
| B | — | 8 |

Table VIII. Frequencies of body proportions of *Pseudosciaena manchurica* (JORDAN & THOMPSON)

Locality: A, Huzan; B, China Sea.
Age: I, one year; II, two years; III, three years; IV, four years, and V, five years old.

Head in body length

| Loc. | 3.00-3.10 | | | | | 3.10-3.20 | | | | | 3.20-3.30 | | | | | 3.30-3.40 | | | | | 3.40-3.50 | | | | | 3.50-3.60 | | | | | 3.60-3.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | — | — | — | — | — | 1 | — | — | — | 1 | 4 | 1 | — | — | 5 | 9 | 3 | — | — | 5 | 2 | — | — | — | 2 | — | — | — | — | 1 | — | — |
| B | — | — | 1 | — | — | 1 | 1 | 2 | — | — | 2 | 1 | 3 | 4 | 1 | — | 1 | 6 | — | — | 1 | — | 3 | — | 1 | — | — | — | — | — | — | — | — | — | — |

Depth in body length

| Loc. | 3.30-3.50 | | | | | 3.50-3.70 | | | | | 3.70-3.90 | | | | | 3.90-4.10 | | | | | 4.10-4.30 | | | | | 4.30-4.50 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | 2 | 1 | — | 2 | 8 | 2 | — | — | 8 | 6 | — | — | — | 3 | — | 1 | — | — | — | — | — | — | — | — | — | — | — |
| B | — | — | 1 | — | — | 3 | 1 | 5 | 2 | — | — | 2 | 3 | 2 | 1 | 1 | — | 5 | — | 1 | — | — | — | — | — | — | — | 1 | — | — |

Snout in head

| Loc. | 4.00-4.10 | | | | | 4.10-4.20 | | | | | 4.20-4.30 | | | | | 4.30-4.40 | | | | | 4.40-4.50 | | | | | 4.50-4.60 | | | | | 4.60-4.70 | | | | | 4.70-4.80 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | 4 | 1 | — | — | — | 6 | — | — | — | 2 | — | 1 | — | — | 3 | 6 | 1 | — | — | 3 | — | — | — | — | 2 | — | 1 | — | — | 2 | — | — | — | — | 1 | — | — |
| B | — | — | 3 | — | — | 1 | — | 2 | — | 2 | 1 | 1 | 3 | 1 | — | — | 1 | 1 | 2 | — | 1 | 1 | 2 | 1 | — | — | — | 3 | — | — | — | — | 1 | — | — | 1 | — | — | — | — |

Orbit in head

| Loc. | 4.10-4.30 | | | | | 4.30-4.50 | | | | | 4.50-4.70 | | | | | 4.70-4.90 | | | | | 4.90-5.10 | | | | | 5.10-5.30 | | | | | 5.30-5.50 | | | | | 5.50-5.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | — | — | — | — | 2 | 1 | — | — | — | 2 | 6 | 1 | — | — | 3 | 3 | — | — | — | 4 | 2 | 2 | — | — | 3 | 1 | — | — | — | — | 3 | 1 | — | — | — | — | — | — |
| B | 3 | — | 2 | — | — | 1 | 2 | 2 | — | — | — | 1 | 7 | 1 | — | — | — | 1 | — | — | — | — | 2 | — | — | — | — | 1 | 1 | 2 | — | — | — | 1 | — | — | — | — | 1 | — |

Maxillary in head

| Loc. | 1.90-2.00 | | | | | 2.00-2.10 | | | | | 2.10-2.20 | | | | | 2.20-2.30 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | 3 | — | — | — | 8 | 11 | 4 | — | — | 4 | 2 | — | — | — | 1 | — | — |
| B | 1 | 1 | 3 | — | — | 3 | 2 | 11 | 3 | 1 | — | — | 1 | 1 | 1 | — | — | — | — | — |

Interorbital space in head

| Loc. | 2.90–3.00 | | | | | 3.00–3.10 | | | | | 3.10–3.20 | | | | | 3.20–3.30 | | | | | 3.30–3.40 | | | | | 3.40–3.50 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | — | — | — | — | 2 | 5 | 1 | — | — | 6 | 6 | 2 | — | — | 5 | 3 | 1 | — | — | — | 1 | — | — | — | 1 | 1 | — |
| B | 1 | — | — | — | — | — | — | 1 | — | — | 1 | 2 | 5 | 1 | 1 | 2 | — | 7 | 2 | 1 | — | 1 | 2 | 1 | — | — | — | — | — | — |

Postorbital part of head in head

| Loc. | 1.60–1.70 | | | | | 1.70–1.80 | | | | | 1.80–1.90 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 3 | 1 | — | — | — | 9 | 10 | 3 | — | — | 2 | 5 | 1 |
| B | — | — | — | — | — | — | 2 | 8 | 4 | 2 | 4 | 1 | 7 | — | — |

Distance from origin of ventral to anal in body length

| Loc. | 2.30–2.40 | | | | | 2.40–2.50 | | | | | 2.50–2.60 | | | | | 2.60–2.70 | | | | | 2.70–2.80 | | | | | 2.80–2.90 | | | | | 2.90–3.00 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | 3 | 1 | — | — | 2 | 5 | — | — | — | 8 | 5 | 1 | — | — | 1 | 2 | 2 | — | — | 2 | — | — | — | — | 1 | 1 | — | — | — | — | — | — | — |
| B | — | — | — | 1 | — | — | — | 1 | — | — | — | — | 3 | 2 | 1 | 1 | 2 | 7 | 1 | 1 | — | — | 2 | — | — | 1 | 1 | 2 | — | — | 2 | — | — | — | — |

Length of caudal peduncle in head

| Loc. | 1.10–1.20 | | | | | 1.20–1.30 | | | | | 1.30–1.40 | | | | | 1.40–1.50 | | | | | 1.50–1.60 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | — | — | — | — | 6 | 1 | — | — | — | 7 | 5 | 1 | — | — | — | 5 | 3 | | — | — | 5 | — |
| B | — | — | — | — | — | 1 | 1 | 3 | 1 | — | 2 | 1 | 8 | 3 | 1 | — | 1 | 3 | — | — | 1 | — | 1 | — | 1 |

Depth of caudal peduncle in head

| Loc. | 3.10–3.20 | | | | | 3.20–3.30 | | | | | 3.30–3.40 | | | | | 3.40–3.50 | | | | | 3.50–3.60 | | | | | 3.60–3.70 | | | | | 3.70–3.80 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | 1 | — | — | — | 3 | 3 | 2 | — | — | 4 | 2 | 1 | — | 5 | 5 | — | — | — | — | 2 | 3 | — | — | — | — | — | 1 | — | — | — | — | 1 | — |
| B | — | — | 1 | — | — | — | — | — | — | — | 1 | — | 4 | — | 1 | — | 1 | 3 | 4 | 1 | 2 | — | 6 | — | — | 1 | 1 | 1 | — | — | — | 1 | — | — | — |

Pectoral in head

| Loc. | 1.00–1.10 | | | | | 1.10–1.20 | | | | | 1.20–1.30 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 3 | 4 | 2 | — | — | 8 | 6 | 1 | — | — | 1 | 2 | — |
| B | 2 | — | 5 | 3 | 1 | 2 | 3 | 9 | — | 1 | — | — | 1 | 1 | — |

Ventral in head

| Loc. | 1.30–1.40 | | | | | 1.40–1.50 | | | | | 1.50–1.60 | | | | | 1.60–1.70 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | — | — | — | — | 3 | 2 | — | — | — | 6 | 6 | 2 | — | — | 2 | 3 | — |
| B | 1 | — | 1 | — | — | — | 2 | 7 | 1 | — | 3 | 1 | 5 | 3 | — | — | — | 2 | — | 2 |

Longest dorsal spine in head

| Loc. | 2.20–2.40 | | | | | 2.40–2.60 | | | | | 2.60–2.80 | | | | | 2.80–3.00 | | | | | 3.00–3.20 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | 1 | — | — | — | 5 | 3 | — | — | — | 3 | 3 | 3 | — | — | 1 | 1 | — | — | — | — | — | — |
| B | — | 1 | 2 | — | — | — | 2 | — | — | — | 2 | — | 7 | 1 | 1 | 1 | — | 2 | 3 | — | — | — | 1 | — | 1 |

Longest dorsal ray in head

| Loc | 2.10–2.20 | | | | | 2.20–2.30 | | | | | 2.30–2.40 | | | | | 2.40–2.50 | | | | | 2.50–2.60 | | | | | 2.60–2.70 | | | | | 2.70–2.80 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | — | — | — | — | 4 | 1 | — | — | — | 3 | 1 | — | — | — | 3 | — | — | — | — | 1 | 1 | 1 | — | — | — | 2 | — | — | — | — | 1 | — |
| B | 2 | — | 3 | — | — | 1 | — | 4 | — | — | — | 2 | 6 | 1 | — | — | — | 1 | 2 | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — |

Second anal spine in head

| Loc. | 5.00–5.50 | | | | | 5.50–6.00 | | | | | 6.00–6.50 | | | | | 6.50–7.00 | | | | | 7.00–7.50 | | | | | 7.50–8.00 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | — | — | — | — | — | 2 | 3 | — | — | — | 2 | 4 | 1 | — | — | 5 | 4 | 1 | — | — | 2 | 3 | 1 | — | — | 2 | 2 | 1 |
| B | 1 | — | — | — | — | 1 | 2 | 1 | — | — | 1 | 1 | 4 | 2 | — | 1 | — | 7 | 1 | 1 | — | — | 3 | — | — | — | — | — | 1 | 1 |

Longest anal ray in head

| Loc. | 1.70–1.80 | | | | | 1.80–1.90 | | | | | 1.90–2.00 | | | | | 2.00–2.10 | | | | | 2.10–2.20 | | | | | 2.20–2.30 | | | | | 2.30–2.40 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | — | — | — | — | 1 | 1 | — | — | — | 2 | 2 | — | — | — | 6 | 6 | — | — | — | — | 2 | — | — | — | — | 1 | — | — | — | — | — | 1 |
| B | — | — | — | — | — | 3 | 2 | 4 | — | — | 1 | 1 | 5 | 2 | — | — | — | 4 | 1 | 1 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | 1 |

Caudal in head

| Loc | 0.90–1.00 | | | | | 1.00–1.10 | | | | | 1.10–1.20 | | | | | 1.20–1.30 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 1 | — | — | — | — | 4 | 1 | 1 | — | — | 5 | 4 | 2 | — | — | 1 | — | 1 |
| B | — | — | 1 | — | — | 4 | 2 | 6 | — | 1 | — | — | 5 | 2 | 1 | — | — | — | — | — |

| Loc | Longest gill-raker on first arch in head | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6.00-7.00 | | | | | 7.00-8.00 | | | | | 8.00-9.00 | | | | | 9.00-10.00 | | | | | 10.00-11.00 | | | | |
| | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V | I | II | III | IV | V |
| A | — | — | 2 | — | — | — | — | 8 | 7 | 2 | — | — | 4 | 5 | 2 | — | — | — | 3 | — | — | — | — | 1 | — |
| B | 3 | 1 | 1 | — | — | 1 | 2 | 12 | 2 | — | — | — | 2 | 2 | 2 | — | — | — | — | — | — | — | — | — | — |

| Loc. | Number of scales on lateral line | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| A | 4 | 4 | 5 | 5 | 6 | 8 | 2 | — |
| B | — | 3 | 3 | 7 | 9 | 2 | 3 | 1 |

| Loc. | Number of soft dorsal rays | | | | | | |
|---|---|---|---|---|---|---|---|
| | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| A | 1 | 2 | 10 | 6 | 9 | 6 | — |
| B | 1 | 2 | 8 | 10 | 5 | — | 2 |

| Loc. | Number of soft anal rays | |
|---|---|---|
| | 9 | 10 |
| A | 23 | 11 |
| B | 15 | 13 |

| Loc. | Number of pectoral rays | | | | | |
|---|---|---|---|---|---|---|
| | 14 | 15 | 16 | 17 | 18 | 19 |
| A | — | 1 | 22 | 9 | 1 | 1 |
| B | 1 | — | 17 | 10 | — | — |

| Loc. | Number of gill-rakers on first arch | | | | | | |
|---|---|---|---|---|---|---|---|
| | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| A | — | 1 | 6 | 12 | 9 | 5 | 1 |
| B | 1 | 3 | 5 | 9 | 7 | 3 | — |

| Loc. | Number of vertebrae (including hypural) | | |
|---|---|---|---|
| | 28 | 29 | 30 |
| A | 1 | 31 | 2 |
| B | — | 27 | 1 |

# One New and an Imperfectly Known Deep-Sea Shrimps[a]

Ituo Kubo

(Received Feb. 10, 1937)

In the present paper, descriptions of one new species, *Pandalus teraoi*, and an imperfectly known species, *Gonatonotus crassus* A. Milne-Edwards, are given. The specimens of both species were collected by G. Abe with trawl at a depth of about 170 fathoms off Mie-ken in the spring of 1936.

Sincere thanks must be expressed to Prof. Arata Terao for his kind supervision under which the present work was carried out. The author is greatly indebted to Mr. G. Abe for supplying the material.

## Genus *Gonatonotus* A. Milne-Edwards (1881)

The genus *Gonatonotus*, as the original author defines it, is near to the genus *Hoplophorus* H. Milne-Edwards[10,11] in important characters, viz., rudimentary incisor process of mandible without any connexion with molar process, and long flabelliform exopodite of first maxilliped. This genus closely resembles the genus *Campylonotus*[5,15,16] Bate in general aspects but it is easily separated from the latter by the following characters: the characteristic form of mandible is as in *Hoplophorus;* exopodites are present on all legs. It follows therefore that the genus *Gonatonotus* must needs be involved under Hoplophoridae according to its general morphological characters. It may be mentioned that Borradaile[6] has paid no attention to the existence of this genus in his classification of decapod crustacea and Sollaud[16,17] has not discussed this genus in his studies on Campylonotidae.

Since this genus was established by A. Milne-Edwards[11], no species belonging to this genus has been added. Though my specimen is closely allied to the type of *Gonatonotus crassus* A. Milne-Edwards[b], it is difficult to make a decisive identification as the original description

(a) Contributions from the Zoological Laboratory, Imperial Fisheries Institute, No. 67.

(b) Obtained from West Indies.

is too brief from the view-points of exact taxonomy. Therefore the present specimen is here provisionally identified with *G. crassus*.

### *Gonatonotus crassus* A. Milne-Edwards

Rostrum long, about 1.4 times as long as carapace, almost horizontally straight in proximal half, distal half curved upwards, upper margin with 7 (sometimes 8 or 9) unmovable spines, the hindmost of which is situated on carapace, lower margin provided with 8 spines in male (Fig. 1, A); in female, rostrum comparatively short, about 0.8 times as long as the length of carapace, slightly curved upwards near its tip.

Carapace smooth, 1.2 times longer than wide, dorsally carinated with 11 movable fine spines, lateral walls traversed on each side by 3 longitudinal carinae as shown in Fig. 1, B, anterior margin armed with a stout antennal spine and a pterigostomian one, orbital margin with a rudimentary tubercular process.

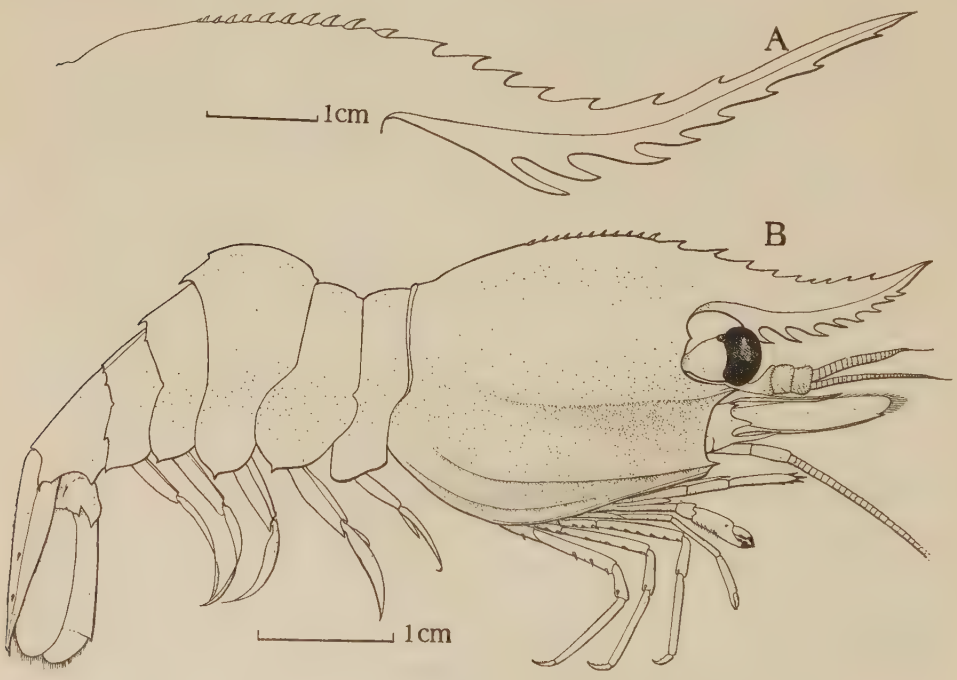


Fig. 1. A. Rostrum of *Gonatonotus crassus* A. Milne-Edwards, ♂.
B. *G. crassus* A. Milne-Edwards, ♀.

Pleura from second to fourth abdominal somites end in a finely-pointed spine. Tergum of third segment strongly carinated in anterior two-thirds of dorsal median, posterior margin terminated in two small spines. Fourth one slightly dorsally carinated, its distal end forming a spine, each posterior lateral margin has a small spine near its middle. Fifth one flat, subtriangular in dorsal aspect, posterior edge with 3 spines on each posterior lateral border, inferior posterior end of the pleura pointed. Sixth somite about 0.63 times as long as telson.

Telson tapering, trapezoid in cross section, upper surface flattish with shallow groove and armed with two pairs of spines set at equal intervals in distal half, terminal margin with 5 spines (Fig. 3, H). Eyes large (cross diameter of cornea 7 mm), ocular spot present. Basal segment of antennular peduncle bears a remarkably long spine reaching

Fig. 2. A. Mandible, ×25. B. First maxilla, ×ca. 10.
C. Second maxilla, ×ca. 7. D. First maxilliped, ×ca. 7
E. Second maxilliped, ×ca. 7.

to nearly middle region of rostrum, ultimate one with two flagella, outer one much thicker and shorter than inner one which reaches to the tip of rostrum. Distal ventral margin of second segment of antennal peduncle with a log spine reaching to the middle of the scale. Antennal scale moderately wide, outer margin terminated in a stout spine which does not exceed the distal margin of the lamella.

Mandible with 3-segmented palp, molar process large, cylindrical, incisor process rudimentary (Fig. 2, A). Posterior process of scaphognathite of second maxilla short, its posterior margin roundish (Fig. 2, C). Endopodite of first maxilliped 3-segmented, exopodite flagelliform, its lobe moderately wide (Fig. 2, D). Third maxilliped robust, ultimate

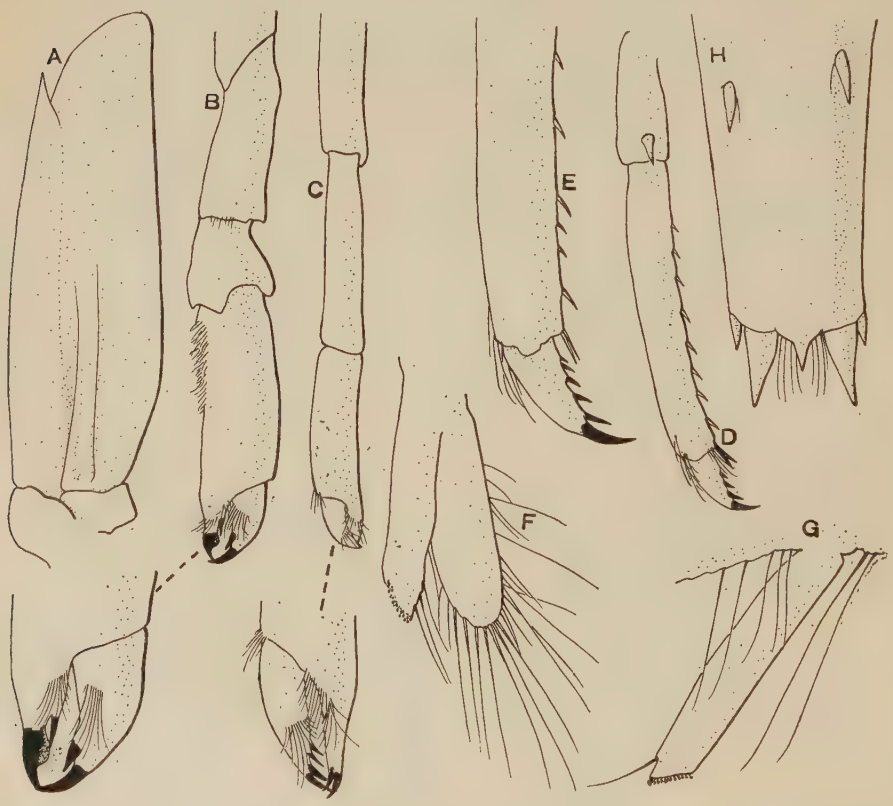


Fig. 3. A. Antennal scale, ×ca. 3. B. First thoracic leg, ×ca. 7. C. Second thoracic leg, ×ca. 7. D. Third thoracic leg, ×ca. 7. E. Distal portion of fifth leg, ×ca. 15. F. Stylumbris and appendix masculina of 2nd abdominal appendage, ♂, ×15. G. Stylumbris of 2nd abd. appendage, ♀, ×25.

segment long, about 4 times as long as penultimate one, distal end with 6 horny black spines.

First thoracic leg robust, shortest of all ambulatory legs, chelate, remaining wide space between both fingers, each finger provided with a spine near middle of its inner margin as shown in Fig. 3, B, carpus remarkably short, about one-third as long as palm. Second one chelate, slender, much longer than the previous one. Third one much longer than second one in full length, dactylus terminated in a horny spine, armed with 5 graduated spines on inner margin, posterior margin of propodus furnished with a regular 10 spines, terminal one of which

Measurements (in mm):—

| Specimen No. | Sex. | † Body length. | L. of carapace. | L. of rostrum. | No. of rostral spine. | L. of 3rd maxilliped. | L. of 1st leg. | L. of 2nd leg. | L. of 3rd leg. | L. of 4th leg. | L. of 5th leg. | L. of 6th abd. somite. | L. of telson. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *1. | ♂ | 97.5 | 30.5 | 44.3 | 11+7/8 | 34.0 | 28 0 | 35.0 | 44.5 | 45.0 | 42.7 | 12.6 | 20.0 |
| 2. | ♂ | — | 28.2 | — | 11+8/7 | 31.0 | 26.0 | 30.7 | 41.0 | 38.5 | 37.0 | 10.0 | — |
| *3. | ♀ | 62.1 | 20.5 | 17.4 | 11+8/8 | 18.0 | 15.9 | 18.0 | 21.6 | 22.0 | 20.0 | 8.0 | 14.0 |
| 4 | ♀ | 63.0 | 21.0 | 17.5 | 12+7/7 | 17.6 | 15.0 | 16.8 | 22.0 | 21.3 | 19.5 | 7.5 | 14.0 |
| 5 | ♀ | 67.0 | 21.0 | 18.0 | 11+9/7 | 18.0 | 15.0 | 19.0 | 23.0 | 21.5 | 20.3 | 7.4 | 14.0 |
| 6 | ♀ | — | 21.0 | — | — | 17.8 | 15.2 | 18.0 | 22.3 | 22.2 | 20.0 | 8.0 | — |
| 7 | ♀ | 62.0 | 20.4 | 18.0 | 12+9/7 | 17.0 | 14.0 | 17.0 | 22.0 | 21.9 | 20.4 | 7.0 | 13.5 |
| 8 | ♀ | 66.0 | 21.7 | 20.0 | 11+8/8 | 16.0 | 15.0 | 17.5 | 24.0 | 22.2 | 20.6 | 8 4 | 14.2 |
| 9 | ♀ | 62.8 | 20.8 | 16.0 | 10+8/7 | 15.5 | 14.0 | 17.0 | 23.0 | 22.0 | 19.0 | 7.0 | 13.6 |
| 10 | ♀ | 67.0 | 22.3 | 20.0 | 12+8/8 | 19.5 | 16.5 | 18.7 | 24.0 | 23.0 | 21.0 | 7.6 | 14.5 |
| 11 | ♀ | 68.0 | 19.0 | 17.0 | —+8/+ | 16.0 | 13.0 | 17.0 | 21.8 | 20.0 | 19.0 | 7.0 | 13.0 |
| 12 | ♀ | 64.8 | 21.2 | 17.5 | 12+7/7 | 17.0 | 15.0 | 17.7 | 22.5 | 21.5 | 19.5 | 7.5 | 14.0 |
| 13 | ♀ | 61.5 | 20.6 | 17.0 | 12+9/8 | 17.0 | 14.1 | 17.2 | 20.6 | 21.0 | 19.0 | 7.3 | 13.5 |

* Description based on these specimen.

† Without rostrum.

paired, carpus short about two-fifths the length of propodus, a spine present near distal end of outer surface. Last two pairs are very similar to third leg in general respects.

Two median forwardly directed processes present on the last thoracic sternum, each process closely juxtaposed in median line in male, but in female each one separated with a narrow interval.

Endopodite of second abdominal appendage with a stylumbris and an appendix masculina on inner margin of its proximal region in male Fig. 3, F), but in female stylumbris only (Fig. 3, G).

Branchial arrangement runs as shown in following list:—

| | *h* | *i* | *k* | *l* | *m* | *n* | *o* |
|---|---|---|---|---|---|---|---|
| Pleuro branchiae | — | r | 1 | 1 | 1 | 1 | 1 |
| Arthrobranchiae | — | 1 | 1 | 1 | 1 | 1 | — |
| Podobranchiae | 1 | 1 | — | — | — | — | — |
| Mastigobranchiae | 1 | — | 1 | 1 | 1 | 1 | — |
| Exopodite | 1 | 1 | r | r | r | r | r |

Colour:—light yellowish brown in life.

Habitat: off Nagasima, Mie Prefecture at a depth of about 150 fathoms.

### *Pandalus teraoi** sp. nov.

New Japanese name: Terao-botan-ebi.

Carapace smooth, dorsally carinated in anterior about two-thirds, produced to a large stout rostrum which is armed on upper margin with 16 remarkably long movable spines, the sixth one from the back probably the longest (as the specimen is a little mutilated, it is impossible determine precisely which spine is the longest), gradually decreasing in their length anteriorly and posteriorly making a peak with longest one as shown in Fig. 5, A, and the posterior 10 spines situated on carapace, with 3 unmovable spines on upper margin of its tip, lower margin with 13 spines. Frontal margin without an orbital

* The specific name is dedicated to Prof. A. Terao to whom the author is much indebted for many favours.

spine, but a long antennal and a small pterigostomian one.

Pleon smooth, dorsally rounded, but third one with a blunt dorsal carina. Fourth and fifth ones notched on either side immediatly above the posterior margin of pleuron. Posterior inferior margin of these pleura pointed. Sixth abdominal somite is about 0.7 times as long as telson.

Telson tapering, dorsal surface with shallow groove and furnished with 7 pairs of small spines in distal two-fifths, distal margin with 5 spines.

Fig. 4. *Pandalus teraoi* sp. nov. ♂, ×ca. 0.7

Eye large, cross diameter of cornea is 5.5 mm, cornea wider than the stalk, a small ocular spot present, touching cornea on dorsal side. Antennular peduncle consists of 3 segments, anterior end of ultimate segment reaches to about the middle of rostrum, and it bears a pair of flagella which are equal in length and a little longer than the length of carapace, outer ramus much thicker than inner one, basal segment carries a small roundish lateral plate on outer margin of it. Breadth of antennal scale comparatively narrow, distal end reaches to about proximal three-fourths of rostrum, outer margin ends in a small spine, its tip well beyond the distal margin of the lamella. Posterior portion of scaphognathite of second maxilla produced to an angular lobe, its posterior inner margin with long hairs. Tip of third maxilliped reaches to the distal end of antennal scale, ultimate segment about

1.5 times as long as penultimate one.

First pair of leg slightly shorter than third maxilliped, non-chelate, near proximal region of the terminal segment densely beset with fine hairs (Fig. 5, C). Second leg asymmetrical, chelate, slender, left leg much longer (about 1.4 times) than right one, carpus with 65 joints in left and 20 in right leg (Fig. 5, D). Dactylus of third leg is somewhat shorter than half of propodus, inner margin armed with 13 graduated spines, posterior margin of propodus densely furnished with large and small spinules, length of carpus is just half as long as propodus, outer

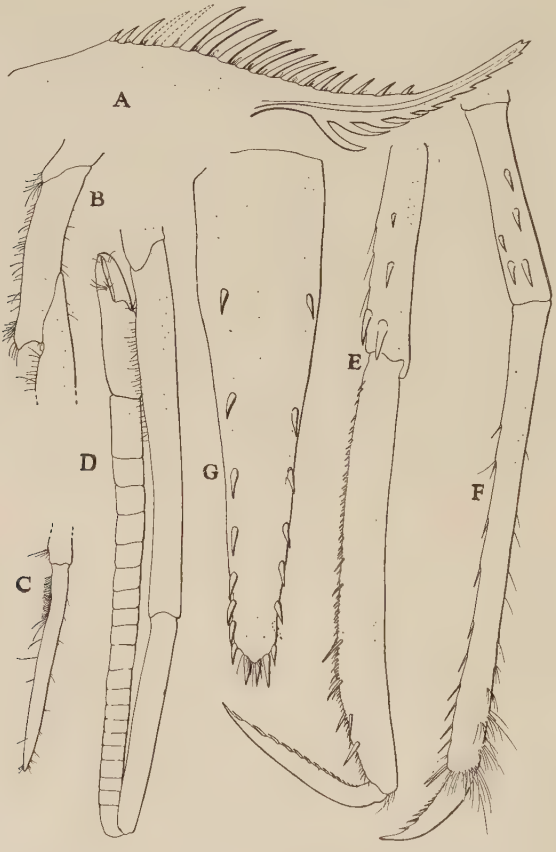


Fig. 5. A. Rostrum, ×4/3. B. Ichium of first thoracic leg, ×4. C. Ultimate segment of first thoracic leg, ×5. D. Second thoracic leg (right), ×4. E. Distal three segments of third thoracic leg, ×5. F. Distal three segments of fifth leg, ×4. G. Telson, ×4.

Fig. 6. A. Tip of the endopodite of first abdominal appendage, ♂, ×10. B. Tip of the endopodite of first abdominal appendage, ♀, ×ca. 13. C. Stylumbris and appendix masculina in endopodite of second abdominal appendage, ♂, ×10. D. Stylumbris in endopodite of second abdominal appendage, ♀, ×ca. 17.

border provided with 4 spines, merus a little more than 2.5 times the length of carpus, outer border armed with 15 spines (Fig. 5, E) Both fourth and fifth legs closely resemble the third leg in general appearance but somewhat shorter than the third one in total length, dactylus a little shorter than the third one, posterior margin of propodus with regularly set, comparatively long spinules instead of densely beset spinules as in third leg (Fig. 5, F).

Endopodite of the first abdominal appendage has a lobe-like appendix with curled microscopic hairs on its inner margin near the tip of it in male, but there is an oval appendage fringed with microscopic hairs in famale as shown in Fig. 6, B. Endopodite of second abdominal appendage with short stylumbris and an appendix masculina on inner margin near its proximal region in male (Fig. 6, C). Appendix masculina stout, sub-cyclindrical, ends in a spine, furnished with spines in distal half of its outer margin. In female, it carries a stylumbris which is a little longer than the one of male, a large tubercle situated on inner side of its proximal region (Fig. 6, D).

Branchial arrangement:—

| | *h* | *i* | *k* | *l* | *m* | *n* | *o* |
|---|---|---|---|---|---|---|---|
| Pleurobranchiae | — | 1 | 1 | 1 | 1 | 1 | 1 |
| Arthrobranchiae | — | 1 | 1 | 1 | 1 | 1 | - - |
| Podobranchiae | 1 | — | — | — | — | — | — |
| Mastigobranchiae | 1 | 1 | 1 | 1 | 1 | 1 | — |

Dimensions (in mm):—

| Specimen No. | Sex. | *Body length. | Length of carapace. | Length of rostrum. | No. of rostral spines. | L. of 3rd maxilliped | L. of 1st leg. | L. of 2nd leg (right). | L. of 2nd leg (left). | L. of 3rd leg. | L. of 4th leg. | L. of 5th leg. | L. of 6th abd. somite | L. of telson. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ♂ | 8.90 | 25.0 | 30.0 | 16+3 / 13 | 38.0 | 36.0 | 47.0 | 67.0 | 59.0 | 52.0 | 52.0 | 12.0 | 18.0 |
| 2 | ♂ | — | 25.4 | — | 17+— / — | 37.4 | 37.0 | — | 64.0 | 58.0 | 52.0 | 51.0 | 11.0 | — |
| 3 | ♂ | 65.5 | 18.3 | 26.0 | 18+3 / 13 | 28.0 | 27.0 | — | 48.0 | 42.0 | 37.4 | 37.0 | 10.0 | 13.5 |
| 4 | ♂ | 59 0 | 16.0 | — | — | 24 5 | 24.6 | — | 44.3 | 37.5 | 31.5 | 32.0 | 8.3 | 12.0 |
| 5 | ♀ | 103.5 | 29.3 | 33 2 | 15+3 / 13 | 43.2 | 41.0 | — | 80.0 | 72.5 | 63.0 | — | 13.5 | 21.1 |
| 6 | ♀ | 93.5 | 26.0 | — | — | 38.0 | 37.5 | 45 5 | 67.0 | 60.0 | 54.0 | 50.5 | 13.0 | 18.0 |
| 7 | ♀ | 95.5 | 27.5 | 30.0 | 18+1 / 10 | 37.8 | 38.0 | 49.0 | 68.0 | 61.0 | 54.5 | — | 13.8 | 19.0 |

1. Holotype. 7. Allotype. * Without rostrum.

Colour: Uniformly yellowish red, dorsal middle region of lateral surface of carapace and middle lateral surface near dorsal apex of third abdominal segment with a large deep red spot. From first to fifth abdominal somites in lower half of body and near the tip of tail fan scattered with many small deep red spots (diameter about 2~4 mm). Tip of third maxilliped tinged with deep red.

*Pandalus teraoi* is closely allied to *P. hypsinotus* BRANDT[7] and *P. nipponensis* YOKOYA[18] but easily separated from them and all other species belonging to this genus by the characteristic long spines aranged on the dorsal carina of carapace.

Depth: 150~170 fathoms.

Type locality: off Ôyama, Prefecture Aiti.

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# On the Geotropic Orientation of a Terrestrial Hermit-Crab, *Coenobita cavipes* Stimpson*

Ituo Kubo

(Received Jan. 25, 1937)

Since Y. Delage (1887) and J. Loeb (1888), many observations have been done and formulated on the geotropic orientation of various kinds of animals on inclined plane. In arthropods, especially in decapod crustaceans, however, it has been little observed. Only one investigation ever done is that on the fiddler crab, *Uca*, by W. G. Crozier and Benjamin Kropp (1928). Inasmuch as in all those previous studies little notice has been paid to the friction of the surface of the creeping plane, the question naturally suggests itself as to whether or not variations of the friction of the plane play an important part in the geotropic orientation of the animals. Therefore three kinds of substances were used for the creeping planes in the present experiment, and the results of it will be given in the following lines.

It is my pleasure to record here a debt of gratitude to Prof. A. Terao for his kind supervision, under which the present study was carried out.

## Material and methods

Twelve individuals of *Coenobita cavipes* Stimpson (Table 1), varying 5.0～2.2 cm in length of cephalothorax and 2.5～13.0 gr in total weight were used. They were brought from Ogasawara Islands to Tôkyô for sale and were fed on vegetables in the laboratory for a few days previous to the experiment.

For creeping planes, 1 m square of wire-netting with meshes of about 2 mm square, paste-board, and plane glass were used. The experiment was performed in a dark room with an electric lamp hanging down from ceiling. Room temperature ranged from 28～30°C. As an additional precaution, the eye of these animals were painted black

* Contributions from the Zoological Laboratory, Imperial Fisheries Institude, No. 68.

Table 1.

| Specimen No. | A | B | C | D | E | F | G | H | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length of cephalothorax (mm) | 15 | 16 | 14 | 15 | 14 | 12 | 15 | 10 | 16 | 11 | 11 | 12 |
| Total weight (gr) | 9.5 | 10.5 | 8.5 | 5.3 | 13.0 | 7.5 | 8.5 | 5.3 | 4.5 | 2.5 | 5.3 | 6.5 |
| Body weight (gr) | 2.8 | 3.5 | 2.5 | 2.8 | 2.5 | 1.5 | 2.8 | 1.3 | 2.8 | 1.3 | 1.1 | 1.5 |
| Shell weight (gr) | 6.8 | 7.0 | 6.0 | 2.5 | 10.5 | 6.5 | 5.8 | 4.0 | 1.8 | 1.2 | 4.2 | 5.0 |
| S.W./B.W. | 0.41 | 0.50 | 0.42 | 1.10 | 0.24 | 4.33 | 2.09 | 3.20 | 0.63 | 0.92 | 4.00 | 3.33 |
| Sex | ♀ | ♂ | ♀ | ♂ | ♂ | ♂ | ♂ | ♂ | ♀ | ♂ | ♂ | ♀ |
| Species of shell | T.A. | T.I. | T.I. | G.S. | T.I. | T.I. | T.I. | G.S. | G.S. | M.C. | M.C. | T.I. |

S.W.....Weight of shell which the animal inhabits. B.W.... Body weight. G.S.....*Ganesella sp.* M.C.....*Monodonta canafifera* LAMARK. T.A.....*Turbo* (*Marmarostoma*) *argyrostomus* LINNE. T.I.....*Thais intermedia* KIENER.

with printing ink as they have extreme sensitivity to light. The animals were first kept with their body entirely within their shells and placed with their head exactly upwards at the center of the start line (XX′ in Fig. 1) which was drawn at about lower one-third from the bottom of the tilting plane, and were made to creep 20 cm in height (*CD* in Fig. 1). At the same time, the distance *BC* was measured and the orien tation angle $\theta$ was obtained as tangent from calculation. Inclination angle $\alpha$ of the creeping plane was adjusted by changing the height *E*.

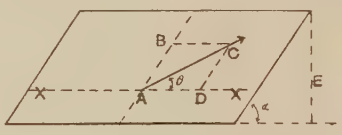

Fig. 1. Diagram showing terms used in this paper.

Each animal was experimented fifteen times for one inclination of the plane and was given a rest of 5∼10 minutes after each five experiments.

## Experiment

The direction of creeping was mostly right-wards in the present experiment, viz. 3848 times for right-wards in 4882 trials. In other wards, they climbed 69.8% to the right and 27.0% to the left against total trials. It may be said, therefore, the direction of the creeping is under the influence of that of the spiral of the shell which the animal inhabits.

The animals presented the following two creeping types during the experiment:—(1) Normal type or dragging type: they crept normally

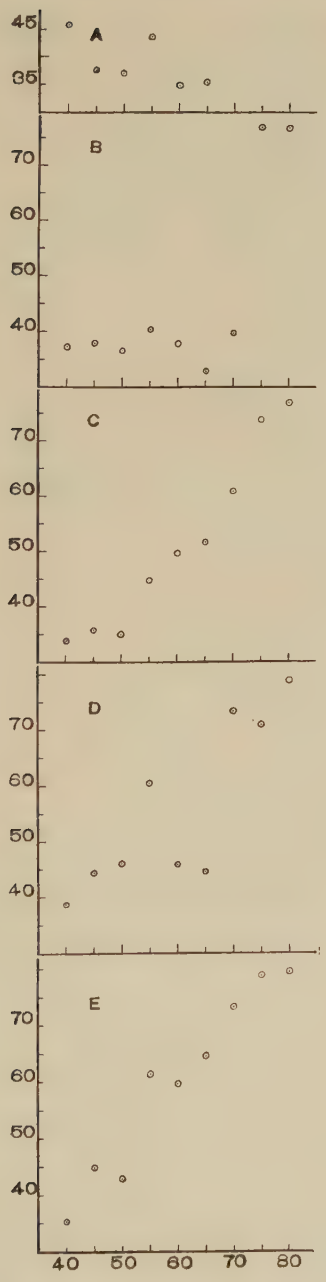


Fig. 2. Graphs showing relation between $\theta$ (ordinate) and $\alpha$ (abscissa), letters agree with cipher of specimen.

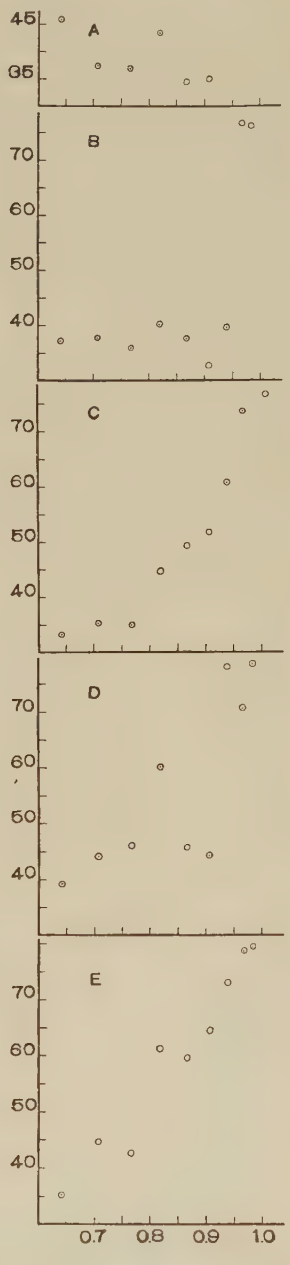


Fig. 3. Graphs showing relation between $\theta$ (ordinate) and sin $\alpha$ (abscissa) letters same as in Fig. 2

with their head protruding forwards as if they were dragging their shell; (2) pushing type: they crept with their head downwards and it seemed just as they were pushing their shell upwards.

When the angle $\alpha$ was small, they crept mainly with normal type, but pushing type was always adopted with larger values of $\alpha$.

**Wire-netting.** On the plane of wire-netting, if $\alpha$ is below 40°, the readings were inconsistent, but above $\alpha=80°$ the animals slipped down and they could not entirely creep up. Near $\alpha=70°$ they changed their climbing type; all the animals resorted to pushing type of creeping. As given in Table 2 and illustrated in Figs. 2 and 3, a rectlinear relation of $\theta$ to sin $\alpha$ was observed in specimen *E* only; that is to say, the formula, $\theta=k\sin\alpha-c$, which was applied for the geotropic orientation of *Uca* by W. J. CROZIER (1928) was approximately applicable (Fig. 3, *E*). But in specimens *C* and *D*, it may be not said that the relation between $\theta$ and $\sin\alpha$ is precisely expressed by such rectilinear function (Fig. 3, *C*, *D*). Especially in specimens *A* and *B*, it is difficult to find such tendency as shown in Fig. 3, *A* and *B*.

Table 2, wire-netting experiment.

| Angle ($\alpha$) / Spec. No. | (Degree) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| A | 45.8 | 37.5 | 37.0 | 43 5 | 34 6 | 35.2 | | | |
| B | 37.2 | 37.9 | 36.5 | 40.2 | 37.6 | 32.9 | 39.6 | 76.8 | 76.3 |
| C | 33.3 | 35.4 | 35.0 | 44.8 | 49.3 | 51.7 | 60.9 | 73.7 | 76.8 |
| D | 38.3 | 44.2 | 46.0 | 60.2 | 45.8 | 44.4 | 78.2 | 70.9 | 78.8 |
| E | 35.3 | 44.8 | 42.9 | 61 4 | 59.6 | 64.5 | 73.0 | 78.8 | 79 5 |

**Paste-board.** Ten individuals were used. The inclination angle $\alpha$ was adjusted from 22 to 36 degrees as shown in Table 3.

The upper limit of $\alpha$ varied with individuals employed, and below $\alpha=22°$, readings were hopelessly inconsistent. The results of the experiment as shown in Table 3 and plotted in Figure 4 are most remarkable of all cases; untill $\alpha$ reached to a certain angle, the orientation angle $\theta$ was approximately constant; and when it reached to a critical point, $\theta$ became suddenly smaller as represented by a break in the graph. The correlation between those critical angles of $\alpha$ and S.W./B.W. of each individual is illustrated in Figure 5, A, its

Fig. 4. Graphs showing relation between $\theta$ (ordinate) and $\alpha$ (abscissa).
A. Specimen B. B. Specimen C. C. Specimen D. D. Specimen F. E. Specimen G.
F. Specimen H. G. Specimen K. H. Specimen L. K. Specimen M. L. Specimen N.

Table 3.

| Spec. No. | Angle (α) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22.0° | 23.0 | 24.0 | 25.0 | 26.0 | 26.5 | 27.5 | 28.0 | 28.5 | 29.0 | 30.0 | 31.0 | 31.5 | 32.0 | 32.5 | 33.0 | 33.5 | 34.0 | 35.0 | 36.0 |
| B | 70.5 | 70.0 | 69.1 | 71.0 | — | 75.0 | — | 74.8 | — | 73.1 | 75.9 | 70.7 | 72.0 | 61.2 | — | 44.2 | — | 38.1 | | |
| C | 75.0 | 78 2 | 74.1 | 68.1 | — | — | — | 71.4 | — | 70.9 | 70.9 | 73.8 | 61.9 | 43.9 | — | 41.2 | — | 27.1 | | |
| D | 72.1 | 71.5 | 69.1 | 74.5 | — | 76 0 | — | 74.9 | — | 79.6 | 69.7 | 70.8 | 77.6 | 73.7 | — | 75.4 | 57.6 | 41.9 | | |
| F | — | — | — | 72.4 | — | — | 72.7 | — | 66.0 | 49 8 | | | | | | | | | | |
| G | — | — | — | 72.4 | 69.2 | — | 77.4 | — | — | 69.5 | 69.1 | 67.8 | — | 74.4 | 43.2 | 43.5 | | | | |
| H | — | — | — | 70.0 | 66.2 | — | 62.6 | — | — | 66.2 | 67.7 | 63.8 | — | 63.9 | — | 43.6 | — | 47.8 | 38.8 | 38.0 |
| K | — | — | — | 71.6 | 66.7 | — | 64.3 | — | — | 63.2 | 66.7 | 64.4 | — | 63.7 | 47.8 | 32.7 | | | | |
| L | — | — | — | 67.2 | 67 0 | — | 64.8 | — | — | 65.2 | 66.6 | 64.2 | — | 67.0 | 35.4 | | | | | |
| M | — | — | — | 72.0 | 69.8 | — | 71.0 | — | — | 67.2 | 66.5 | 53.4 | — | 40.4 | 34.8 | | | | | |
| N | — | — | — | 72.1 | 73.7 | — | 73.1 | — | — | 61.5 | 64.9 | 52.5 | — | 42.9 | | | | | | |

Table 4

| Specim. | S.W./B.W. | α′ | α″ |
|---|---|---|---|
| B | 0.50 | 31.75 | 25.0 |
| C | 0.42 | 31.25 | 28.0 |
| D | 1.10 | 33.25 | 33.5 |
| F | 4.33 | 28.75 | 26.0 |
| G | 2.09 | 32.25 | 29.0 |
| H | 3.20 | 32.50 | 26.0 |
| K | 0.63 | 32.25 | 32.0 |
| L | 0.92 | 32.25 | 29.0 |
| M | 4.00 | 30.50 | 32.0 |
| N | 3.30 | 30.50 | 27.5 |

α′....where a break happened in Fig. 4.
α″....where the animals changed their creeping mode. S.W./B.W.....Same as in table 1.

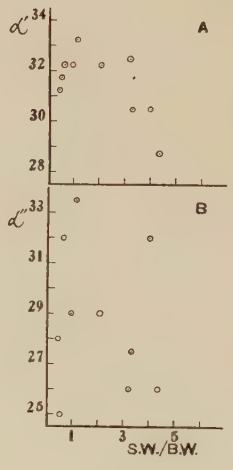


Fig 5. α′, α″ and abbreviation same as in table 4.

correlation coefficient being 0.6. An experimental formula, $y=-1.1x+34$, may be applied approximately to the results.

Between such a value of α as the creeping mode of the hermit-crabs changed to pushing type and S.W./B.W. of the experimental animals, no relation was seen as shown in Fig. 5, B.

Table 5

| Specim. \ Angle ($\alpha$) | 8° | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| A | 62.4 | 63.1 | — | 64.3 | — | 42.8 | — | 38.1 | 39.1 |
| B | 60.9 | 77.1 | 61.6 | 63.8 | 49.5 | 50 3 | 38.1 | 38.2 | 36 5 |
| C | 65.1 | 72.8 | 68.8 | 61.7 | 54.2 | 48.6 | 40.6 | 43.5 | 36.2 |
| D | — | 73.5 | — | 61.8 | — | 47.8 | 37.4 | 38.5 | 42.3 |

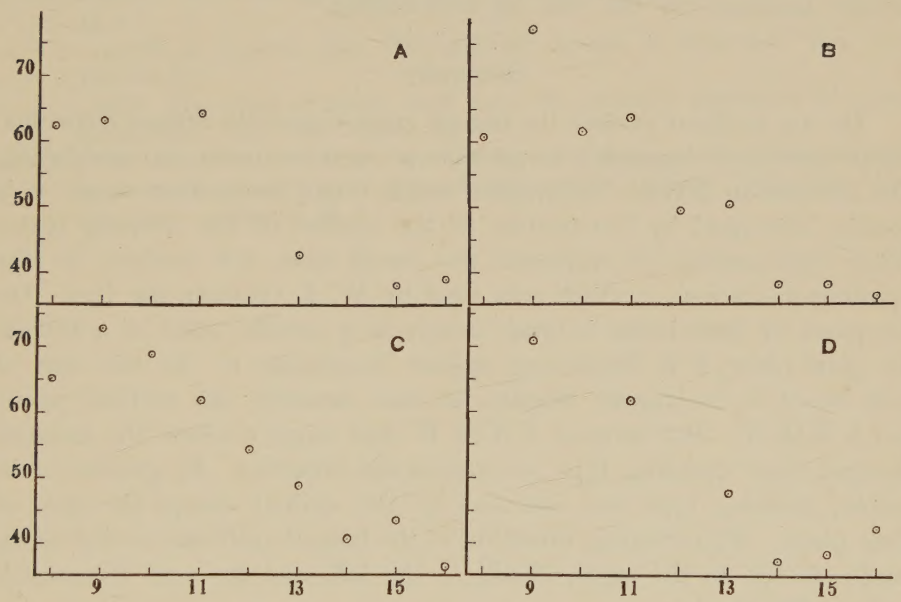


Fig. 6. Graphs showing relation between $\theta$ (ordinate) and $\alpha$ (abscissa). Letters agree with the cipher of Specimen.

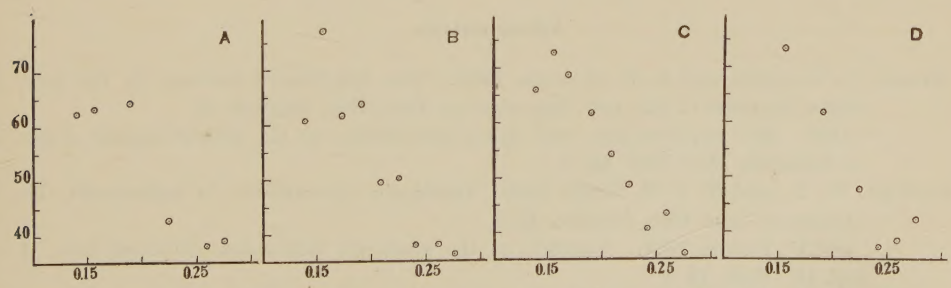


Fig. 7. Graphs showing relation between $\theta$ (ordinate) and $\sin\alpha$ (abscissa) in the same specimens as in Fig. 6.

**Plane glass.** The inclination angle was regulated between 8°~16°, at multiples of 1°. During the course of this experiment, the animals always resorted to the normal type of creeping, and not changed their climbing mode. It seemed due to the fact that the glass surface was too smooth for them to change their creeping form. The obliquely upwards orientation path was accompanied by repeated slipping when $\alpha$ is nearly as large as 16°. The results of this observations are given in Table 5, and plotted in Figures 6 and 7. The graph represents just reverse tendency to the case of wire-netting.

## Summary

On an inclined surface the hermit crab, *Coenobita cavipes* STIMPSON, creeps obliquely upwards; it presents a negative geotropic orientation. The correlation between orientation angle $\theta$ and inclination angle $\alpha$ is greatly influenced by the friction of the surface of the creeping plane. When wire-netting is employed the result does not conform to the equation $\theta = k \sin \alpha - c$ which was used by W. J. CROGIER for *Uca*. On the plane of paste-board a break occurs at a certain value of $\alpha$ and on the glass plane, $\theta$ is decreasing against increasing $\alpha$. In the case of paste-board, a rectilinear relation is seen between the critical points and *S.W./B.W.* But between *S.W./B.W.* and angle $\alpha$ where the animals changed their creeping type no relationwas observed. In greater inclination, pushing type was assumed by the animal except the case of glass plane. The creeping direction of the hermit crab was mostly rightwards; 69.8% to the right, 27.0% to the left, and the rest downwards against 4882 trials.

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